

HOMESTAKE MINING COMPANY SITE

Background Ground Water Investigation

September 16, 2015

MARK PURCELL

U.S. EPA Region 6

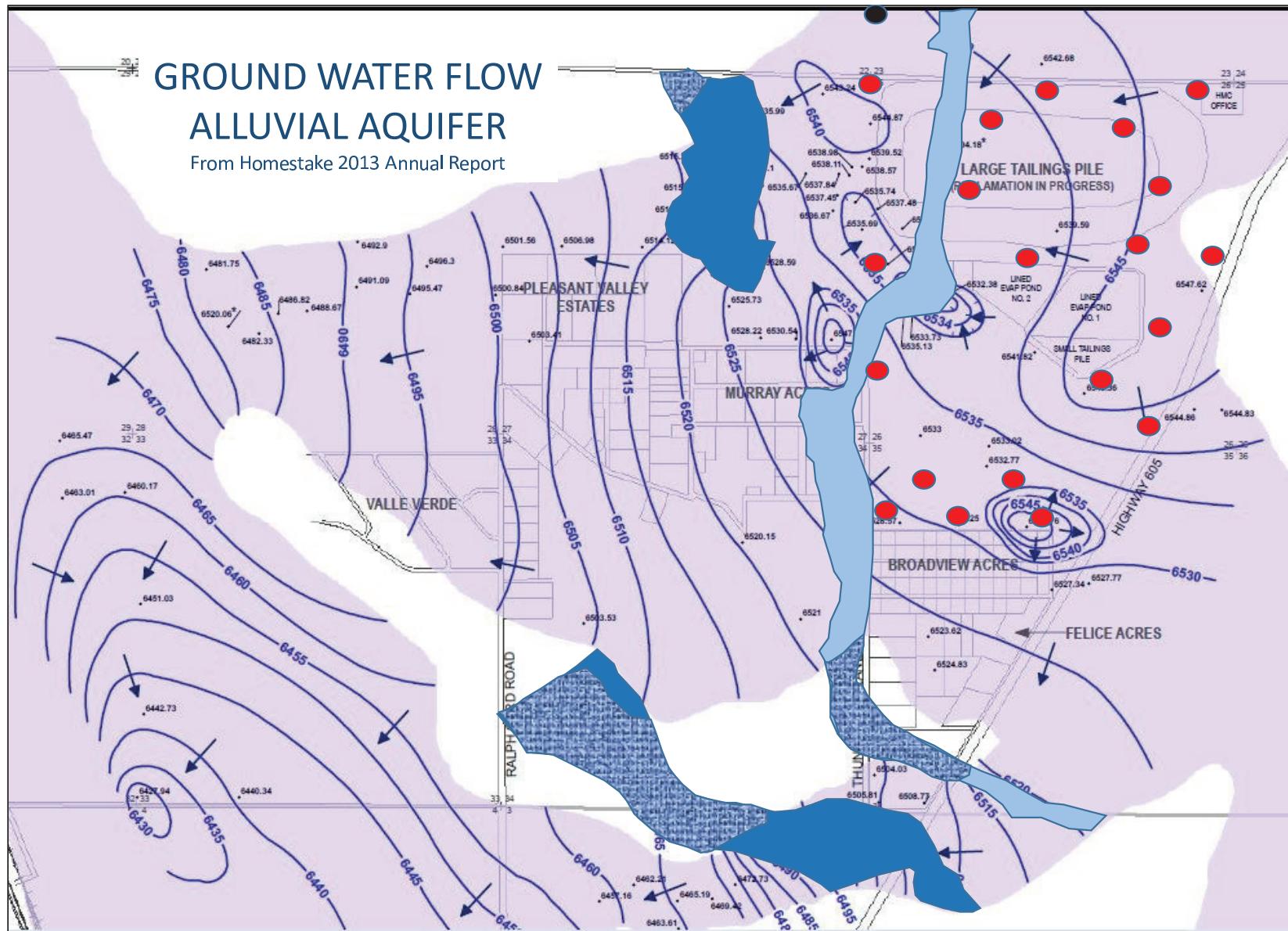


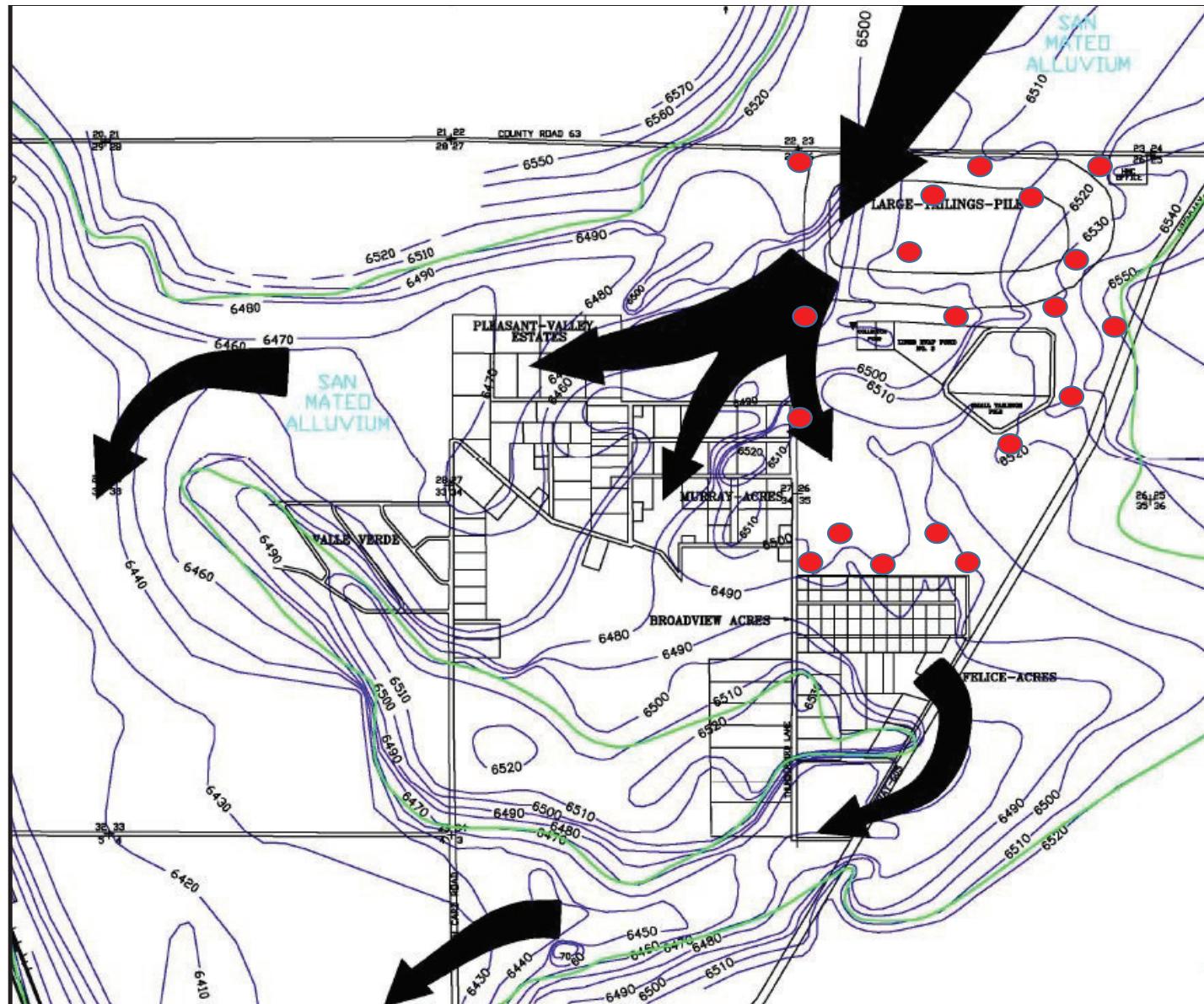
9787581

GROUND WATER FLOW ALLUVIAL AQUIFER

From Homestake 2013 Annual Report

- Well DD
- 1960 Drilling Program
- Upper Chinle Subcrop
- Middle Chinle Subcrop



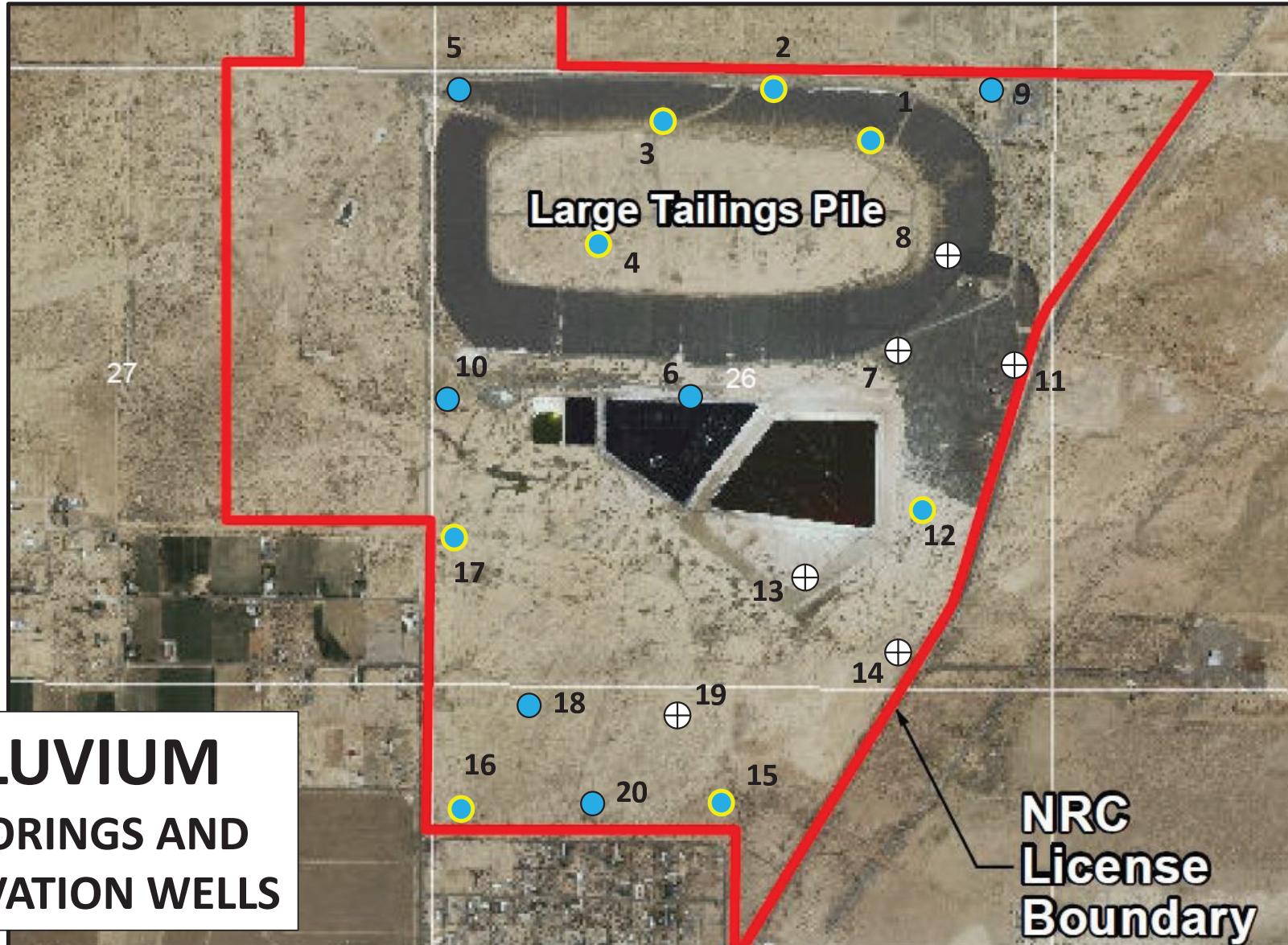


BASE FLOW ALLUVIAL AQUIFER

From HMC
Background Report

- Water likely, Cavings Prevented Probing Bottom of Borehole
- Water
- Dry
- 10 Bore Hole No.

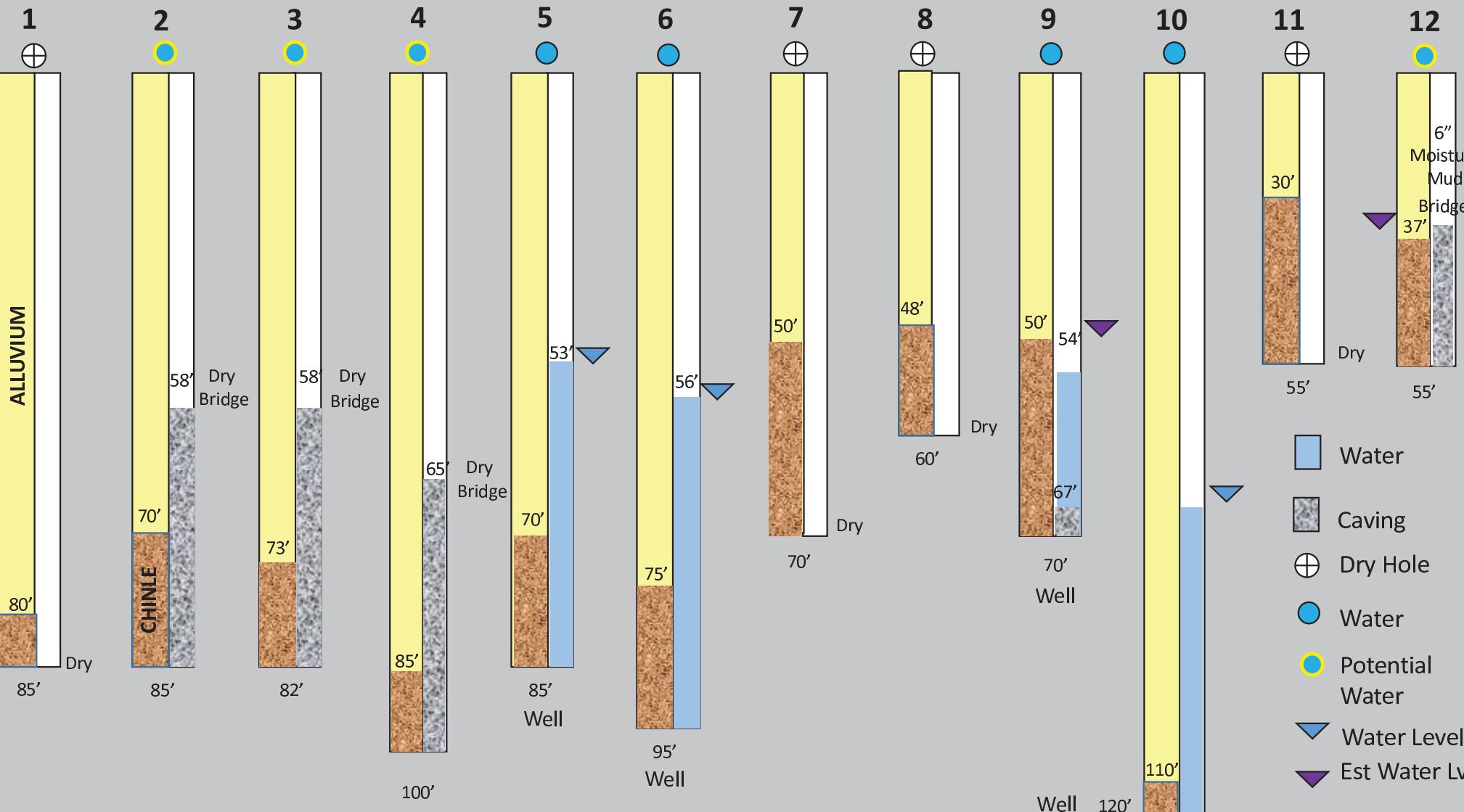
Figure Modified from Homestake CAP



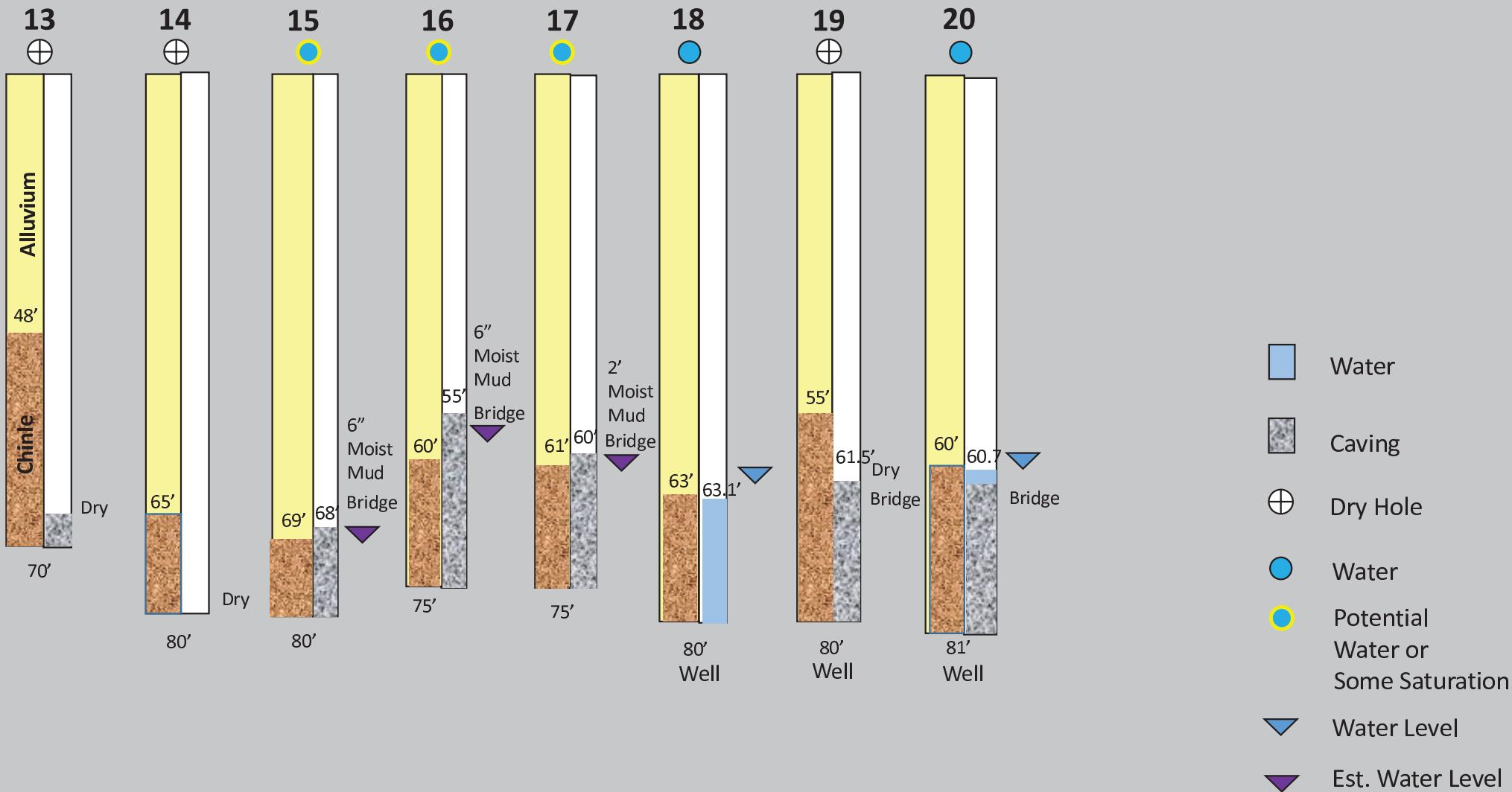
**ALLUVIUM
1960 BORINGS AND
OBSERVATION WELLS**

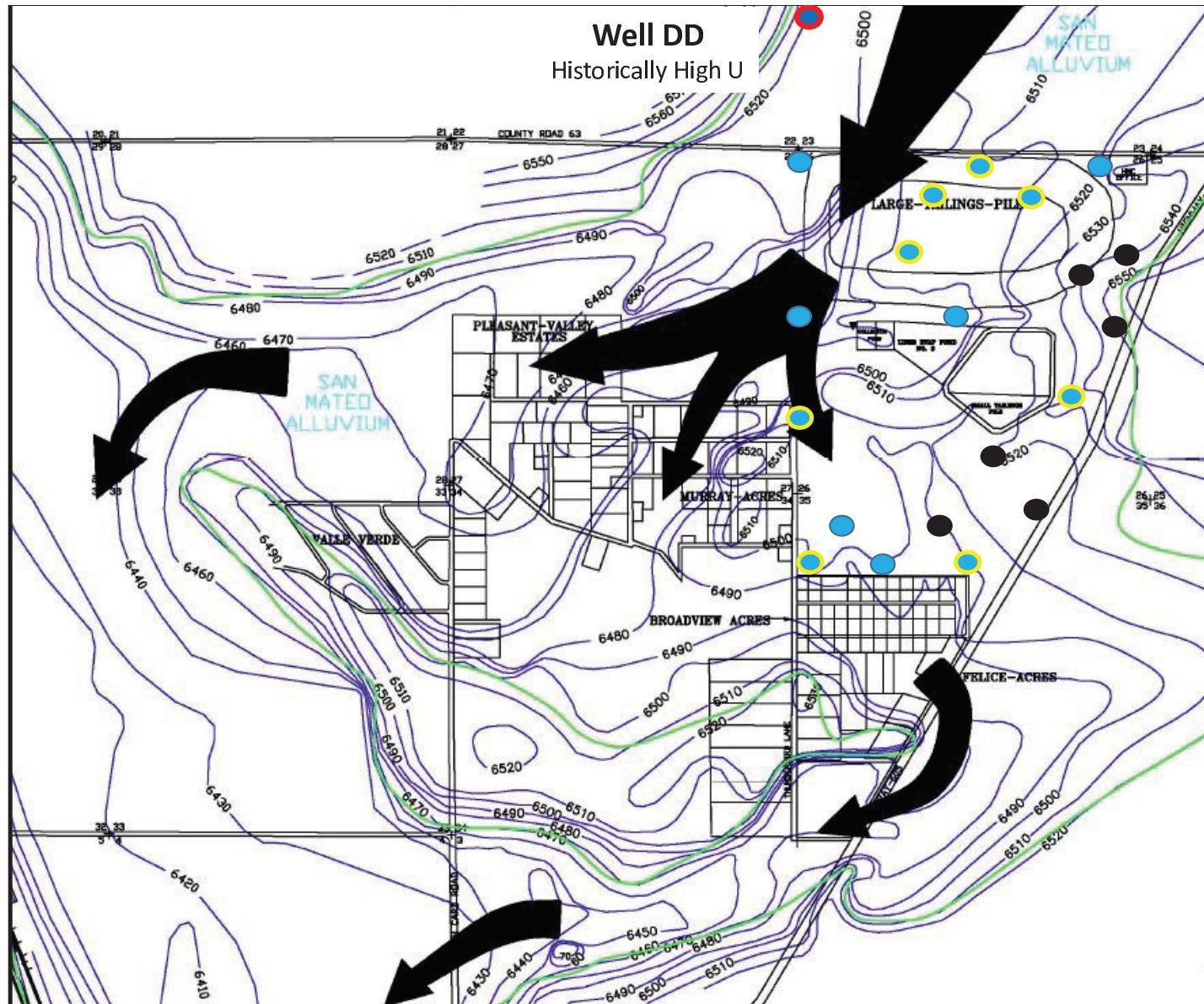
**NRC
License
Boundary**

1960 BORINGS AND OBSERVATION WELLS



1960 BORINGS AND OBSERVATION WELLS



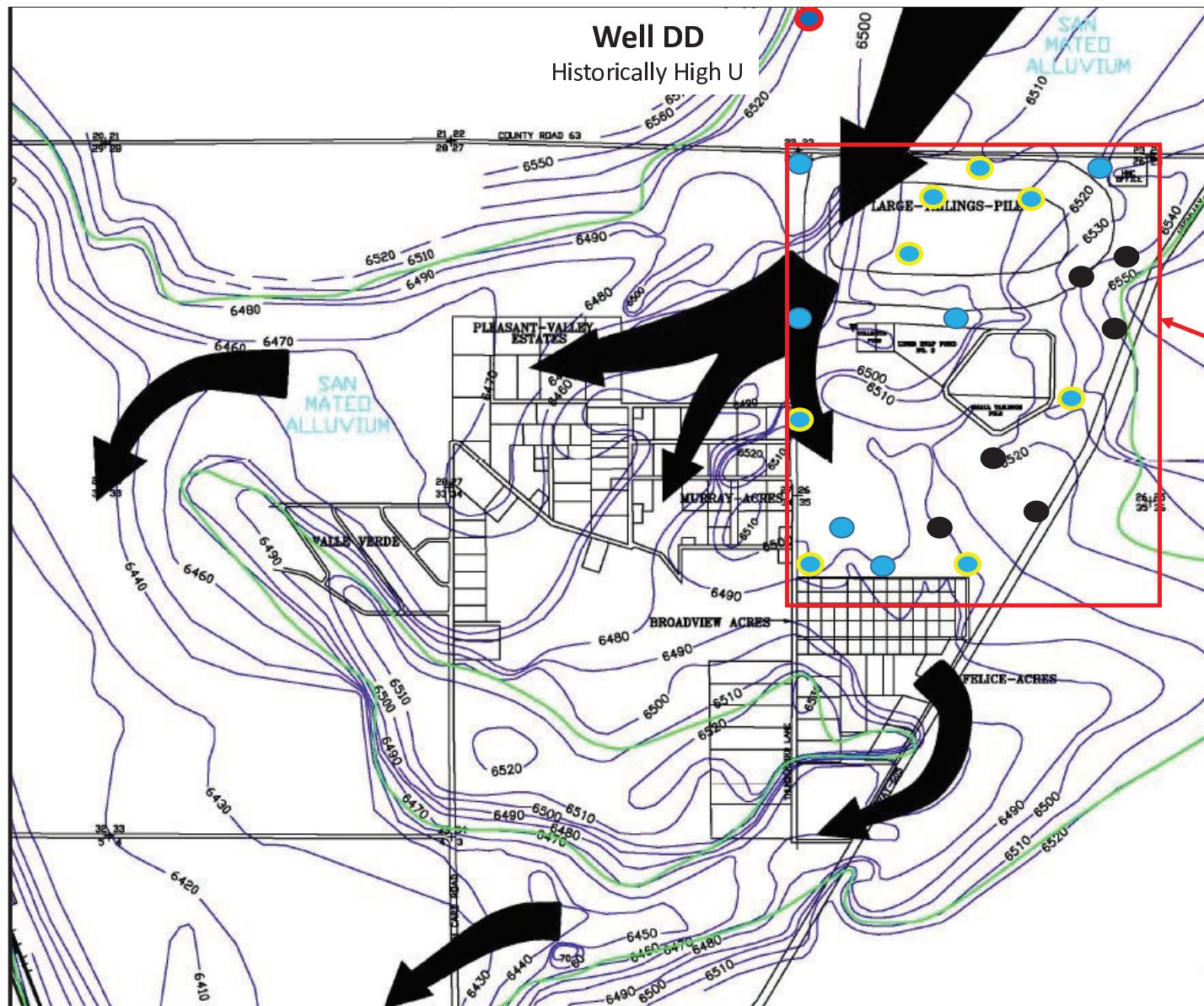


1960 Borings

- Dry Boring
- Potential Water
- Water

BASE FLOW ALLUVIAL AQUIFER

From HMC
Background Report





3.1 $\mu\text{C/L}$ Radium 226

11 Well Number

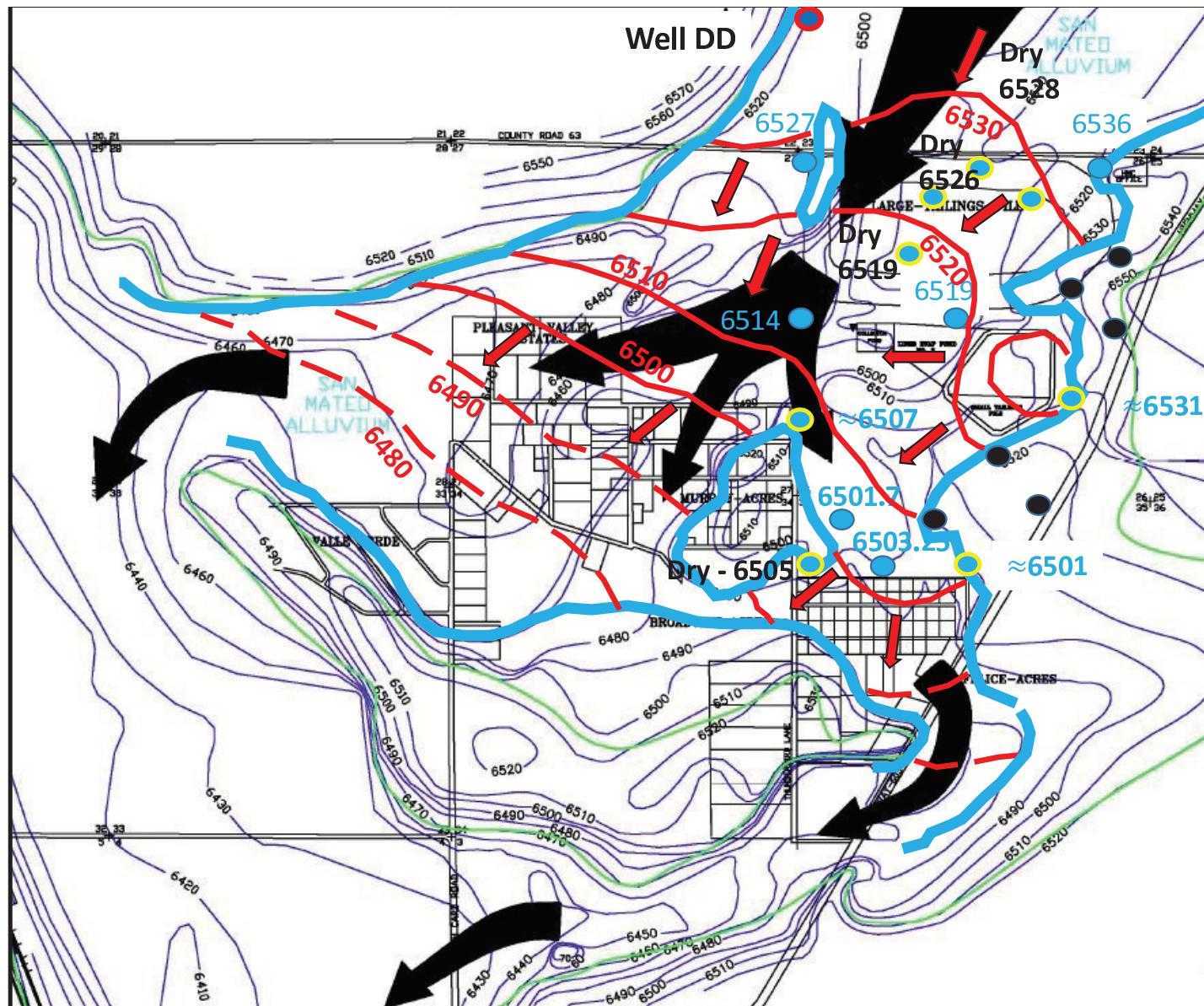
42' Saturation Thickness

6508 Water Elevation

Water Level Contour

Aquifer Boundary

Base of Alluvium Structure Contour and Ground Water Flow Map

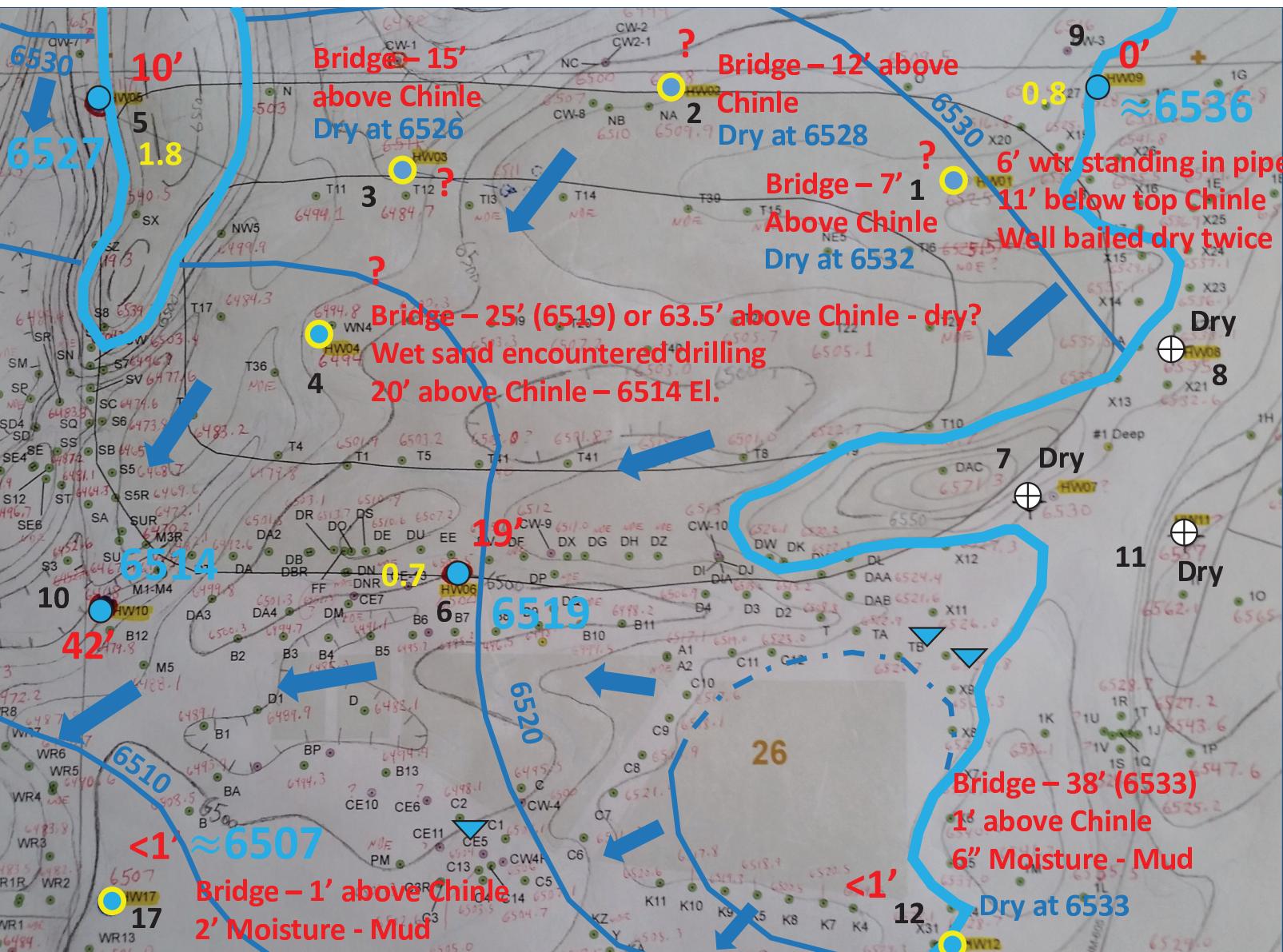


Estimated Saturation Prior to Mill Tailing Disposal Operations



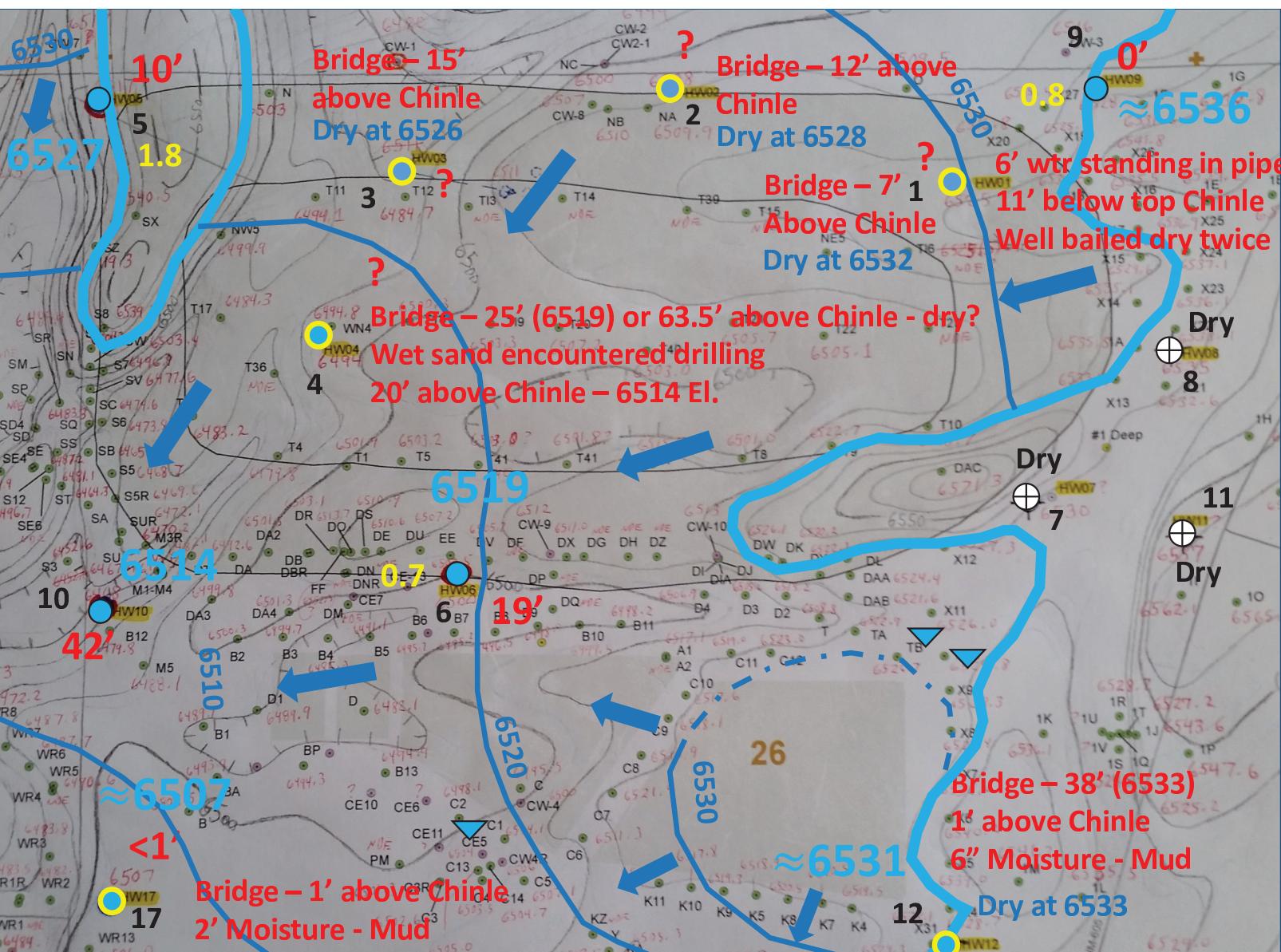
- 11 Well Number
- 42' Saturation Thickness
- 6508 Water Elevation
- Water Level Contour
- Aquifer Boundary

Base of Alluvium Structure Contour and Ground Water Flow Map



- 3.1 $\mu\text{C/L}$ Radium 226
- 11 Well Number
- 42' Saturation Thickness
- 6508 Water Elevation
- Water Level Contour
- Aquifer Boundary
- Old Exploratory Well

Base of Alluvium Structure Contour Map



- 3.1 $\mu\text{C/L}$ Radium 226
- 11 Well Number
- 42' Saturation Thickness
- 6508 Water Elevation
- Water Level Contour
- Aquifer Boundary
- Old Exploratory Well

**Base of Alluvium
Structure Contour
Map**



11 Well Number

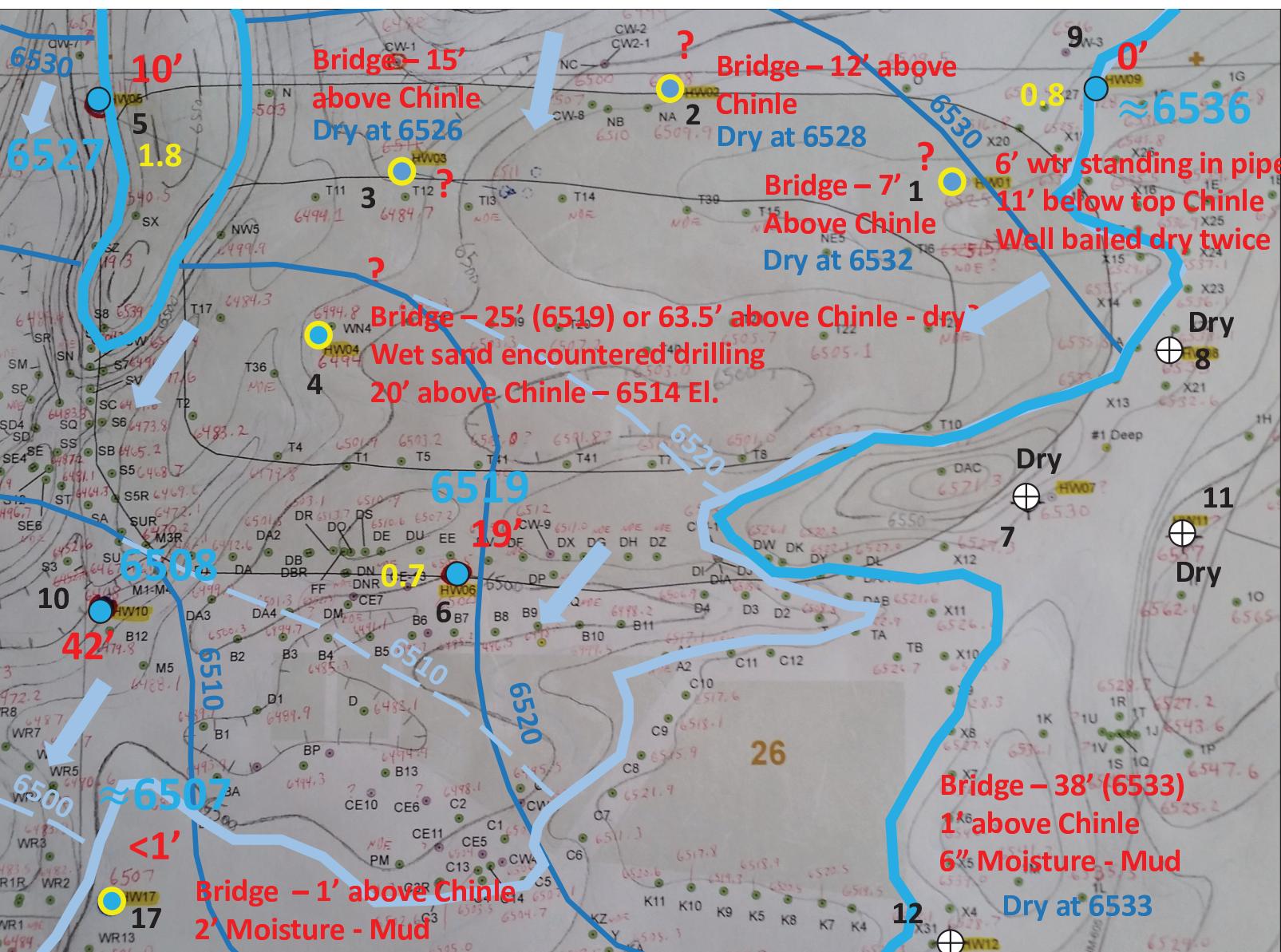
42' Saturation
Thickness

6508 Water Elevation

▼ Old Exploratory Well

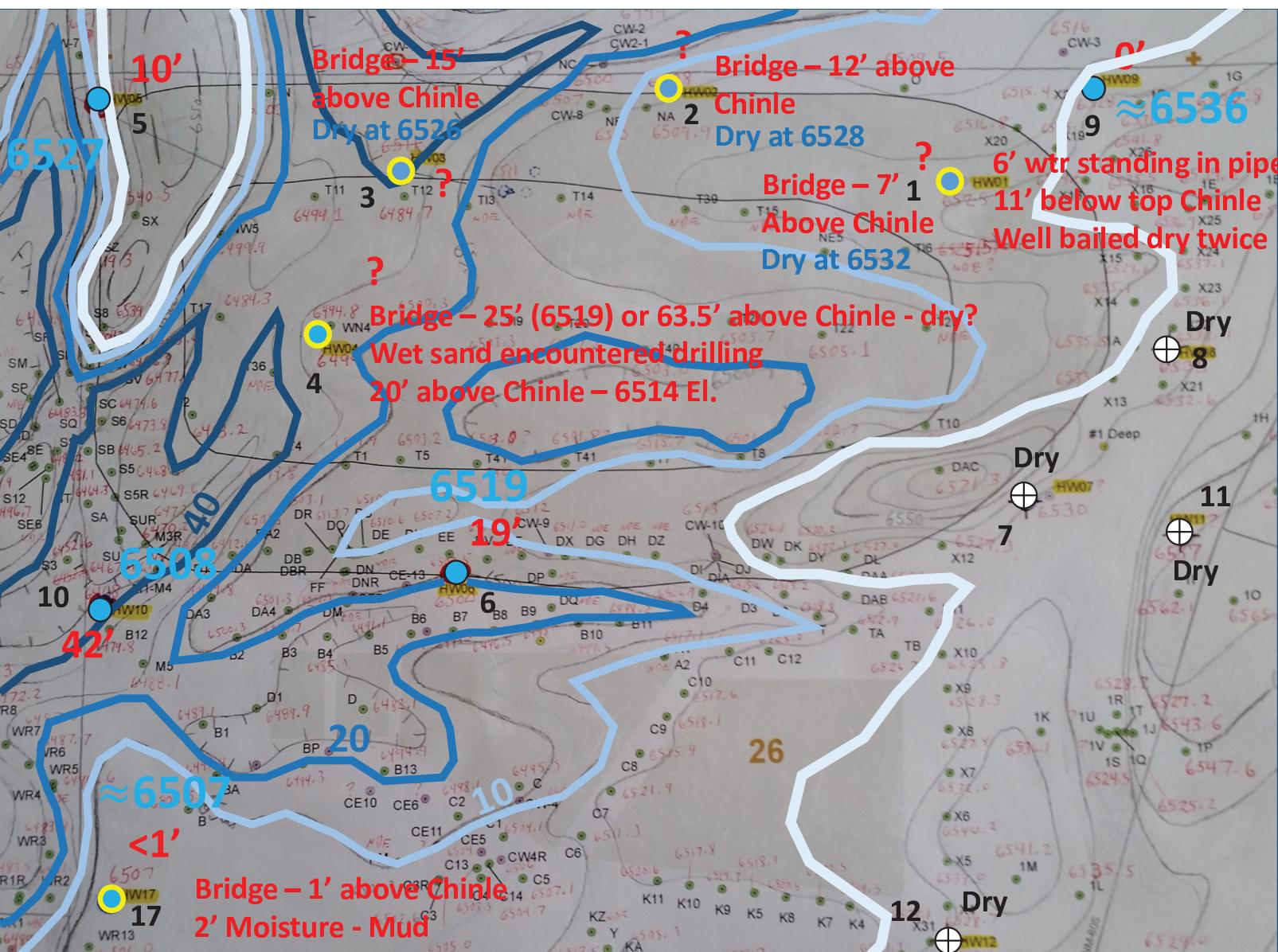
3.1 $\mu\mu\text{C/L}$ Radium 226

Base of Alluvium Structure Contour Map



**Base of Alluvium
Structure Contour
Map**

- 3.1 $\mu\mu\text{C/L}$ Radium 226
- 11 Well Number
- 42' Saturation Thickness
- 6508 Water Elevation
- Water Level Contour
- Aquifer Boundary



- 11 Well Number
- 42' Saturation Thickness
- 6508 Water Elevation
- Water Level Contour
- Aquifer Boundary

Base of Alluvium Structure Contour Map



11 Well Number

42' Saturation Thickness

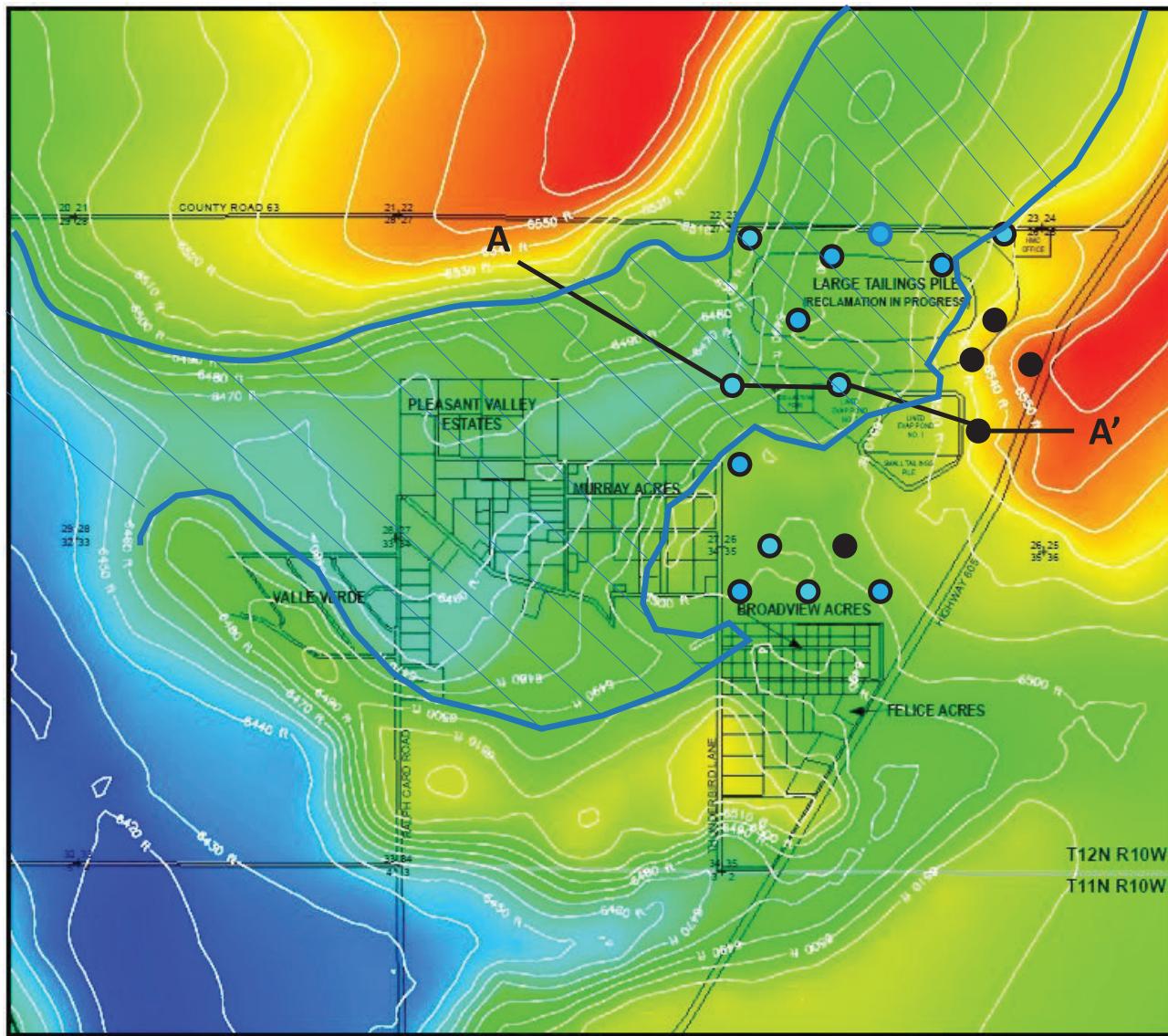
6508 Water Elevation

▼ Old Exploratory Well

Estimated Extent of Saturation in Alluvium Prior to Milling Operations

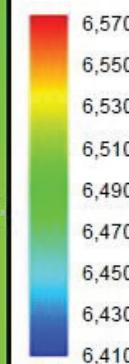
Estimated Extent of Saturation in Alluvium In 1960

Base of Alluvium Structure Contour Map



SATURATED ALLUVIUM BEFORE 1960 AND MILLING

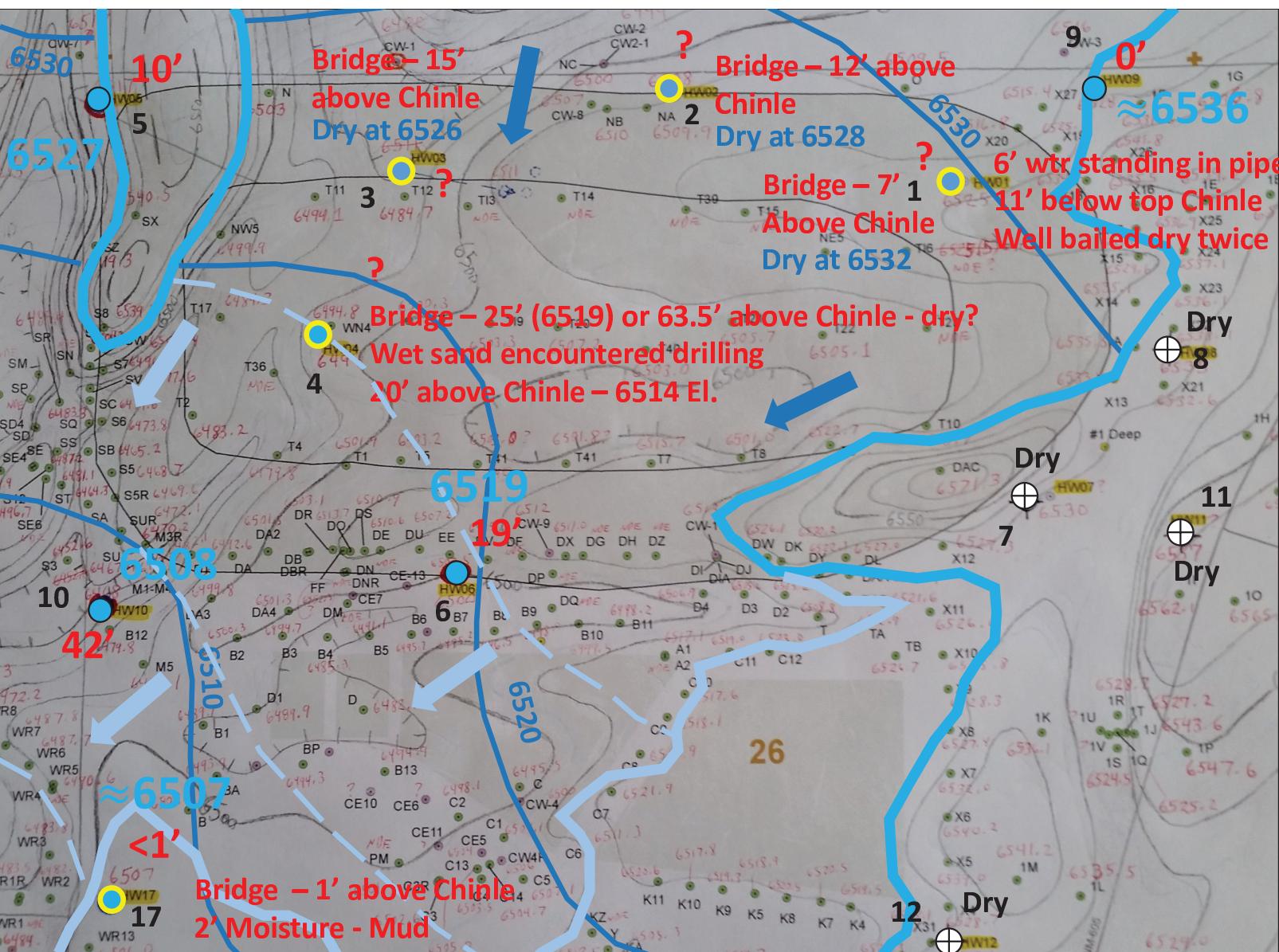
- Water in Borehole
- Dry Borehole



BASE OF ALLUVIUM
ELEVATION
(FT-AMSL)

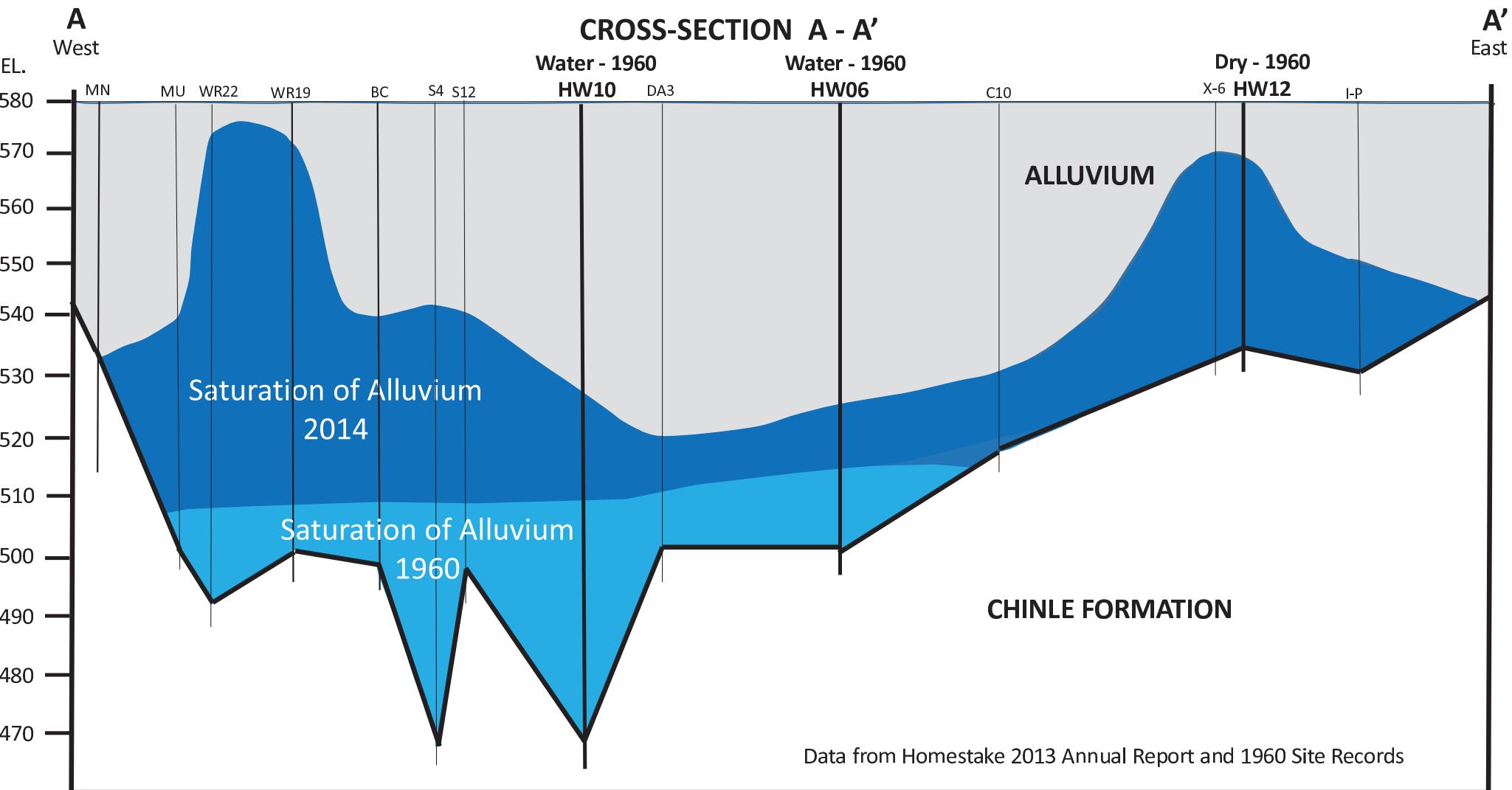
Modified From Homestake CAP

EXTRA SLIDES



- 11** Well Number
- 42'** Saturation Thickness
- 6508** Water Elevation
- Water Level Contour
- Aquifer Boundary

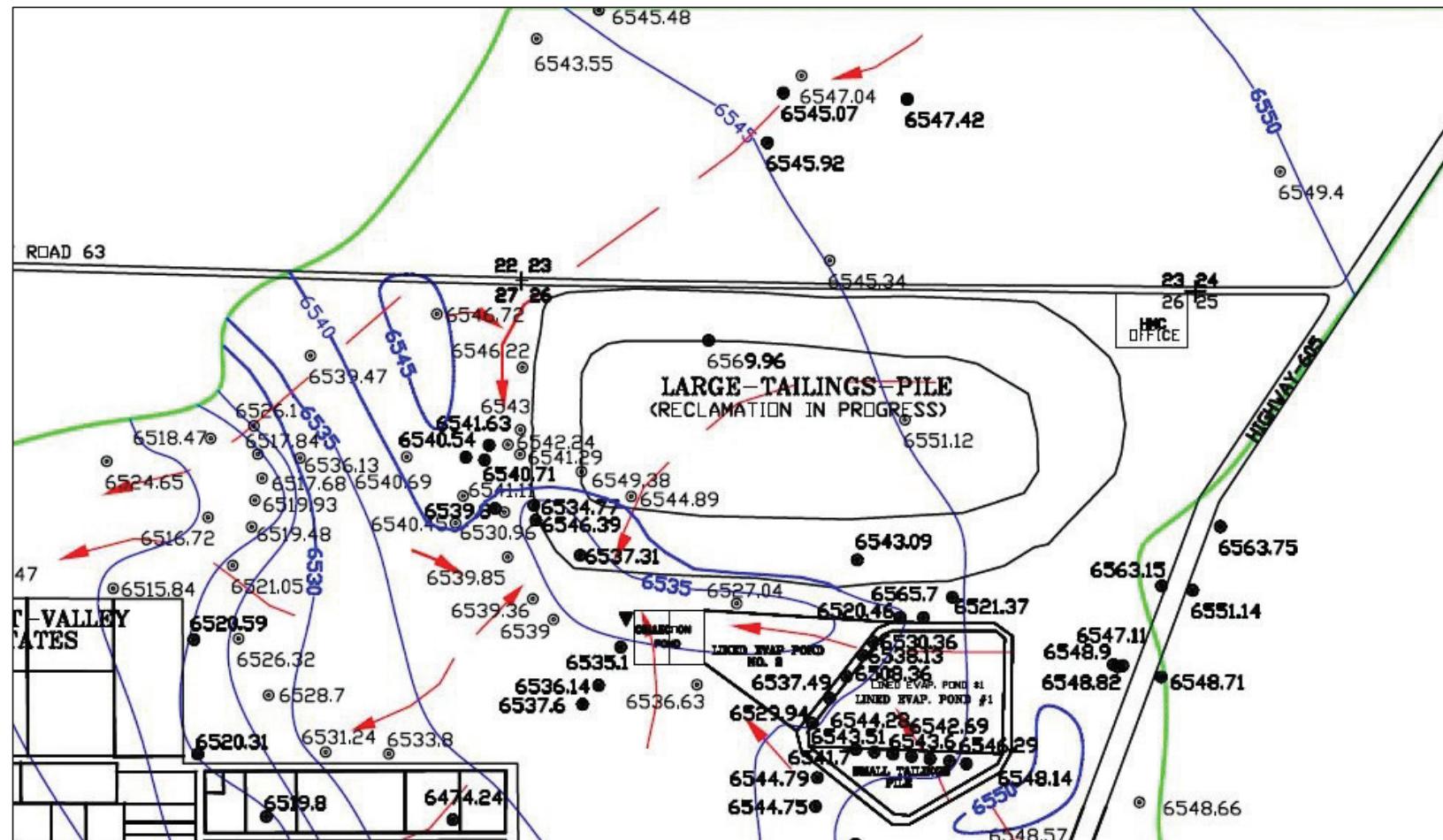
**Base of Alluvium
Structure Contour
Map**



HOMESTAKE MINING COMPANY NPL SITE

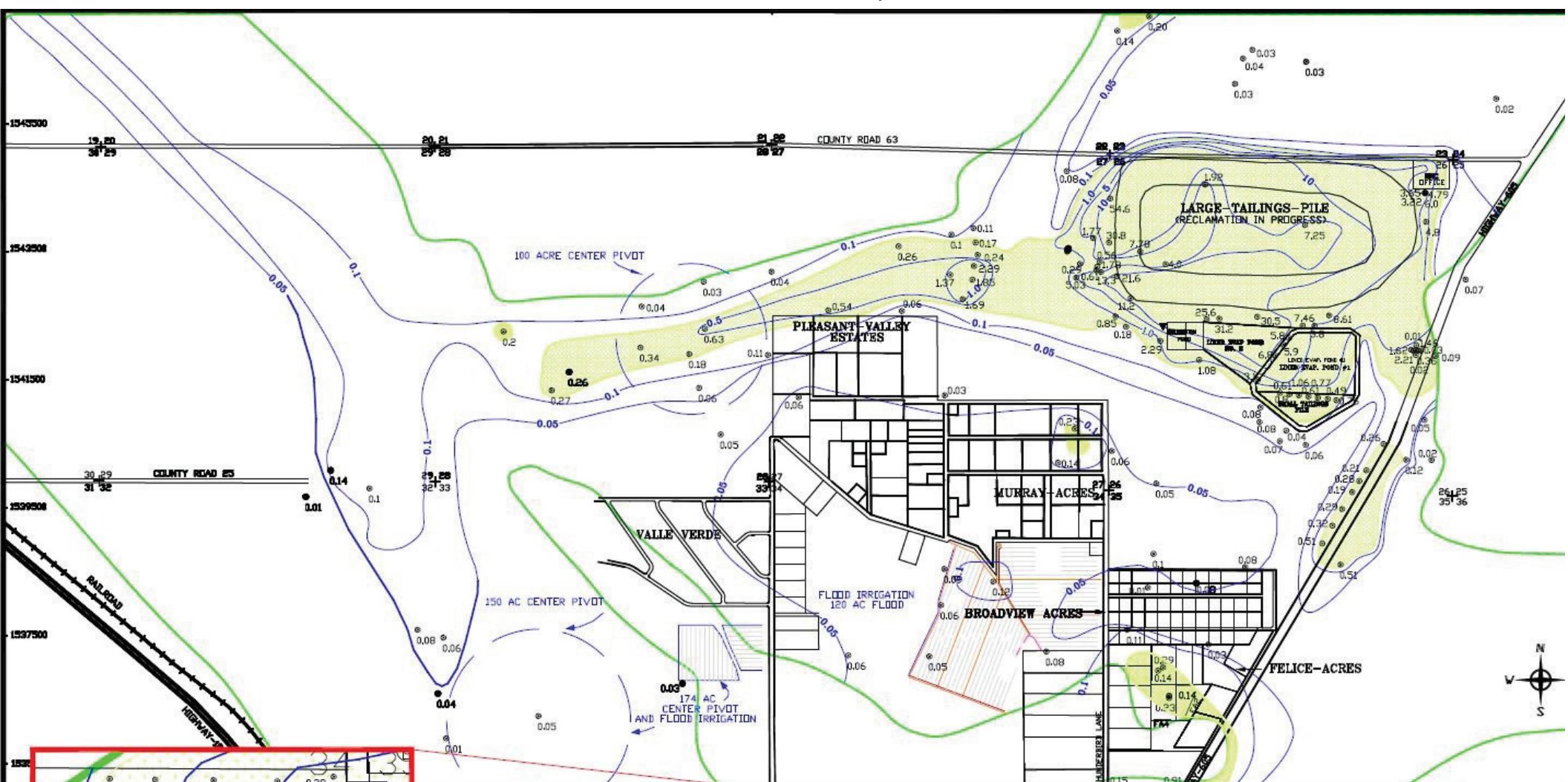
ALLUVIUM POTENTIOMETRIC SURFACE MAP

Homestake 2013 Annual Report



URANIUM CONCENTRATIONS – ALLUVIAL AQUIFER

Homestake 2013 Annual Report



CHINLE AQUIFERS

BACKGROUND WATER QUALITY ASSESSMENT

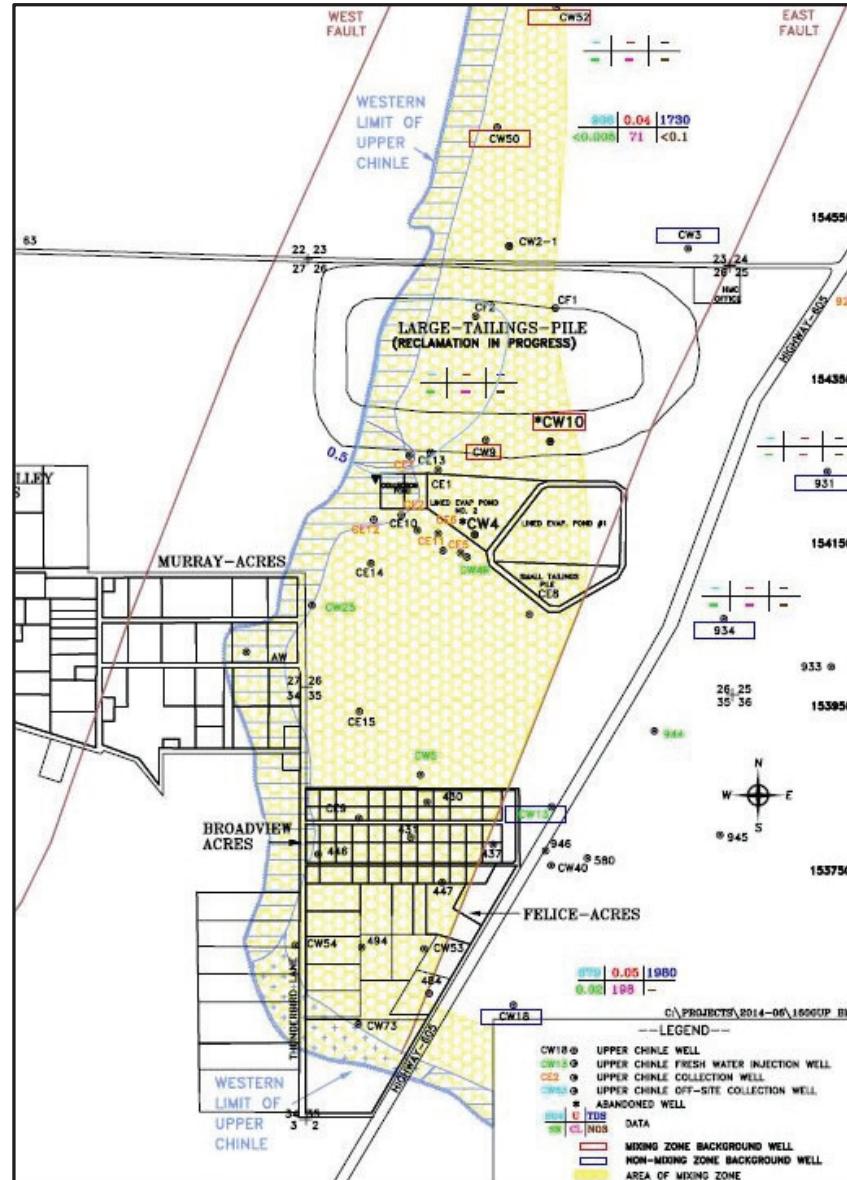
UPPER CHINLE

Mixing Zone wells

- CW-50 and CW-52 are in good locations
- CW-9 and CW-10 not in best locations but water appears to be of better quality

Non-Mixing Zone Wells

- 931 and 934 are in good locations
- Why are Uranium levels in CW-3, CW-13 and CW-18 are so high?



Data Availability

- CW-50 and CW-52 – 2003 to Present
- CW-9 – 1987 to 2000
- CW-10 – 1987 to 1994
- 931 – 1982 to 2000
- 934 – 1982 to 2003
- CW3 – 1984 to 2001*
- CW13 and CW18 – 1994 and 1995, respectively, to 2003

* Well CW3 samples collected after 2001 were not used. The constituent concentrations are elevated due to continuous pumping at that well

Map from Homestake 2013 Annual Report

UPPER CHINLE BACKGROUND WELL DATA

	Well	Uranium (ppb)	Selenium (ppb)	Molybdenum (ppb)	Sulfate (ppm)	TDS (ppm)
Cleanup Standards (MZ)		180	140	100	1750	3140
Mixing Zone	CW-50*	41-42	<5-7	<30		
	CW-52*	9-41	17-28	<30		
	CW-9	<8.5-55	<10-25	<30-110		
	CW-10	12-50	<1-7	<10-20		
Cleanup Standards (NMZ)		90	60	100	914	2010
Non-Mixing Zone	CW-3	02-76	05-68	10-50	566-1,050	920-2,130
	CW-13	45-96	36-244	<30		
	CW-18	16-148	<10-129	<30-50		
	931	04-50 (144?)	05-30	10-110 (420)	608-779	1,290-2,160
	934	08-93 (361)	05-63	10-230	620-821	1,549-1,930

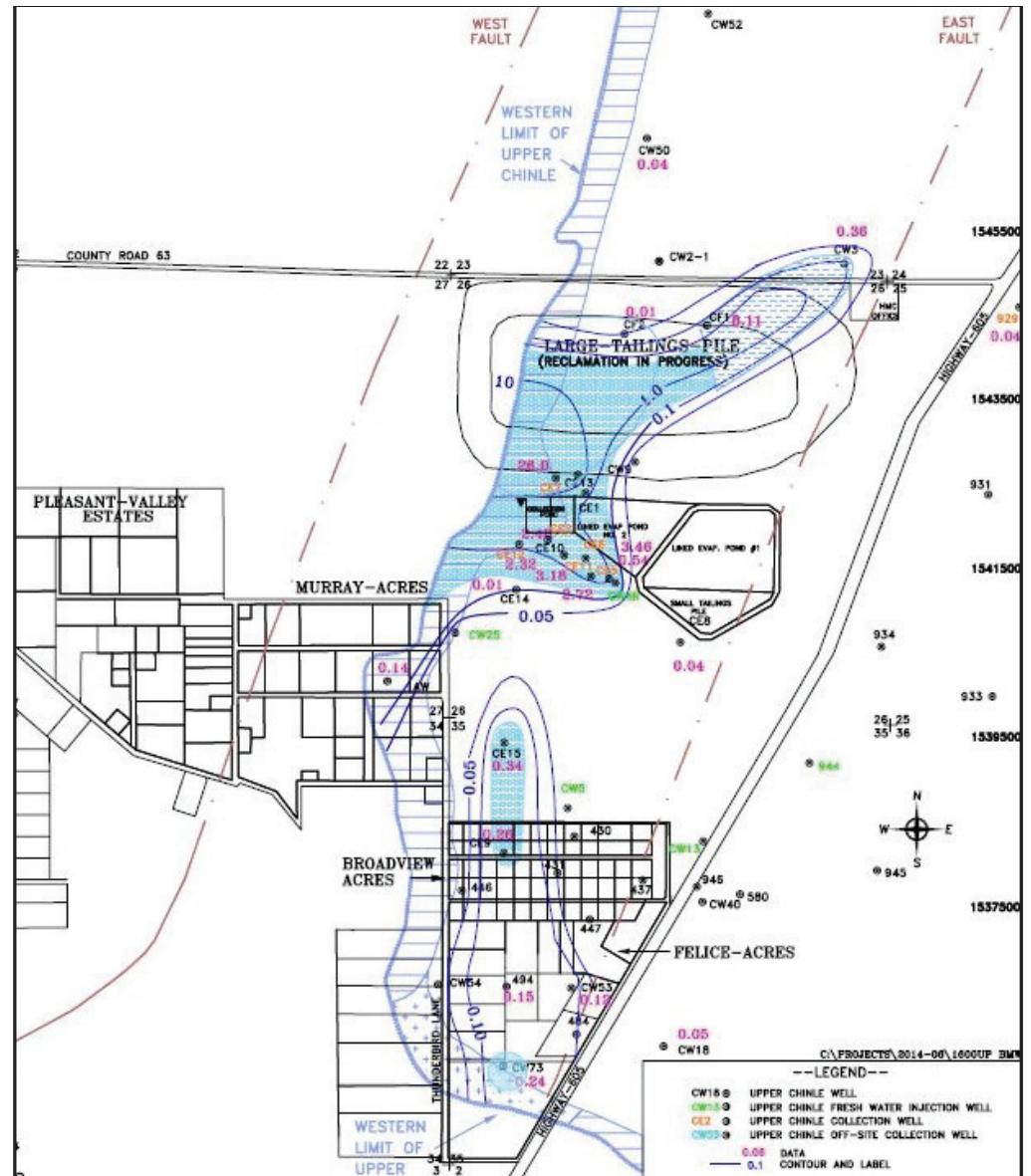
*Only two sampling events data available

Data from Homestake 2003 Statistical Evaluation Report

URANIUM ISOCONCENTRATION CONTOUR MAP

Upper Chinle

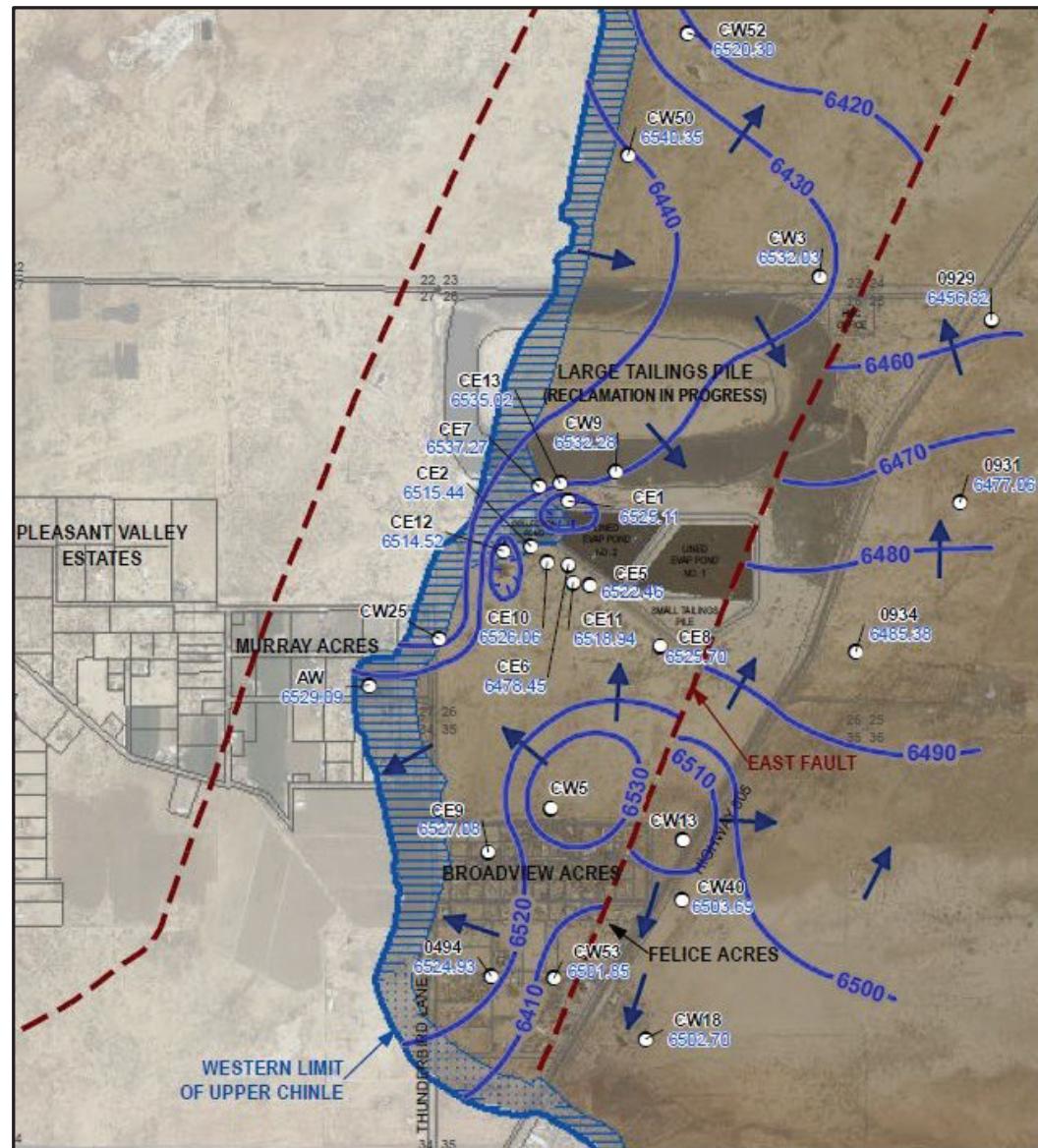
Homestake 2013 Annual Report



GROUND WATER FLOW DIRECTION

Upper Chinle

Homestake CAP



MIDDLE CHINLE

Mixing Zone Wells

- CW-15, CW-17, CW-24, CW-35, WR25 - Reasonable

Non- Mixing Zone Wells

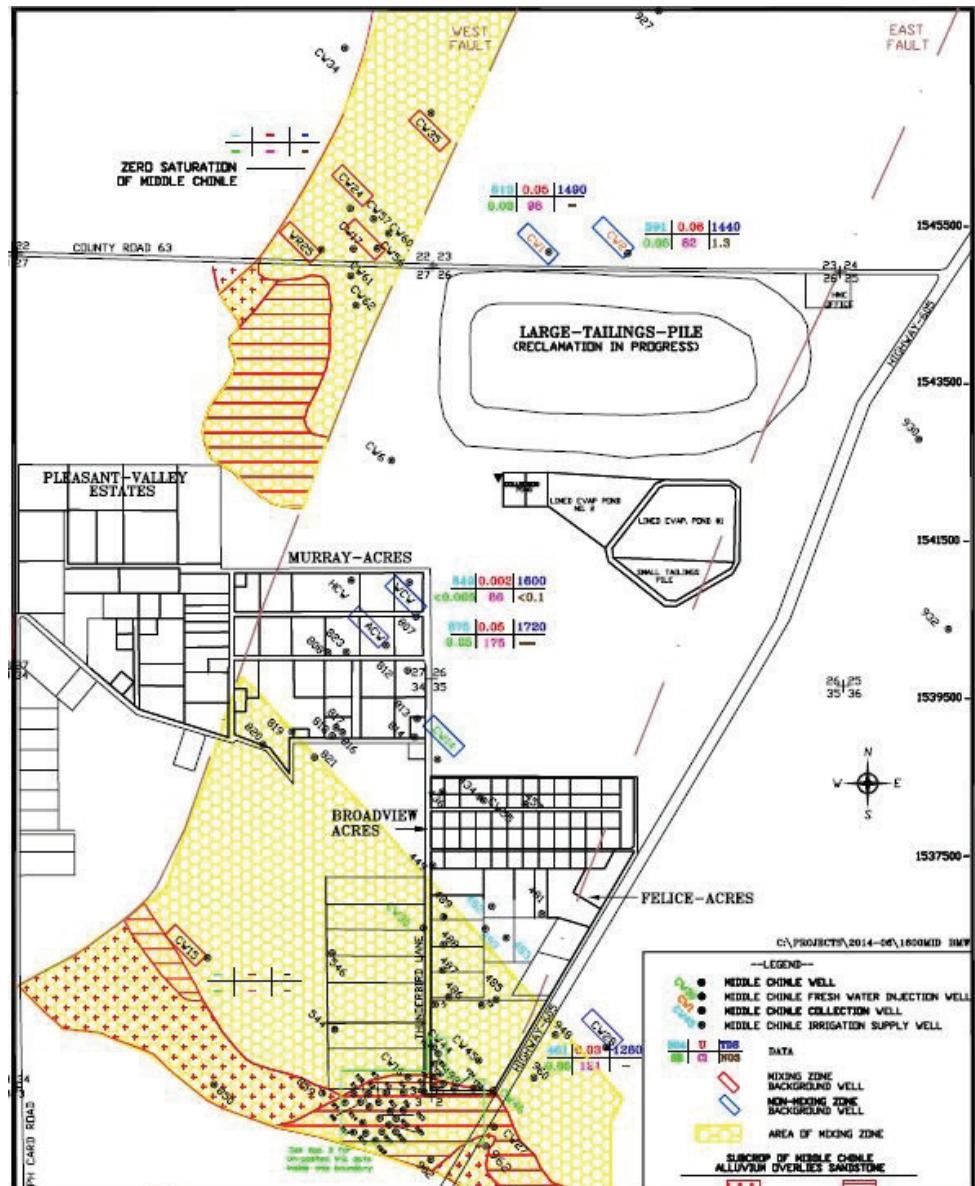
- CW1, CW2 CW-28, ACW, WCW - Reasonable
- CW-14 appears impacted by Se
- Why not use 930 or 932 for background?

Data Availability

- CW-1 and CW-2 – 1982-2003
- CW-14- 3 samples from 1995
- CW-28 – 1995-2003
- WCW- 1980-2000

Why is chemistry in Mixing Zone west of west fault used for background in east of west fault

Map from Homestake 2013 Annual Report



MIDDLE CHINLE BACKGROUND WELL DATA

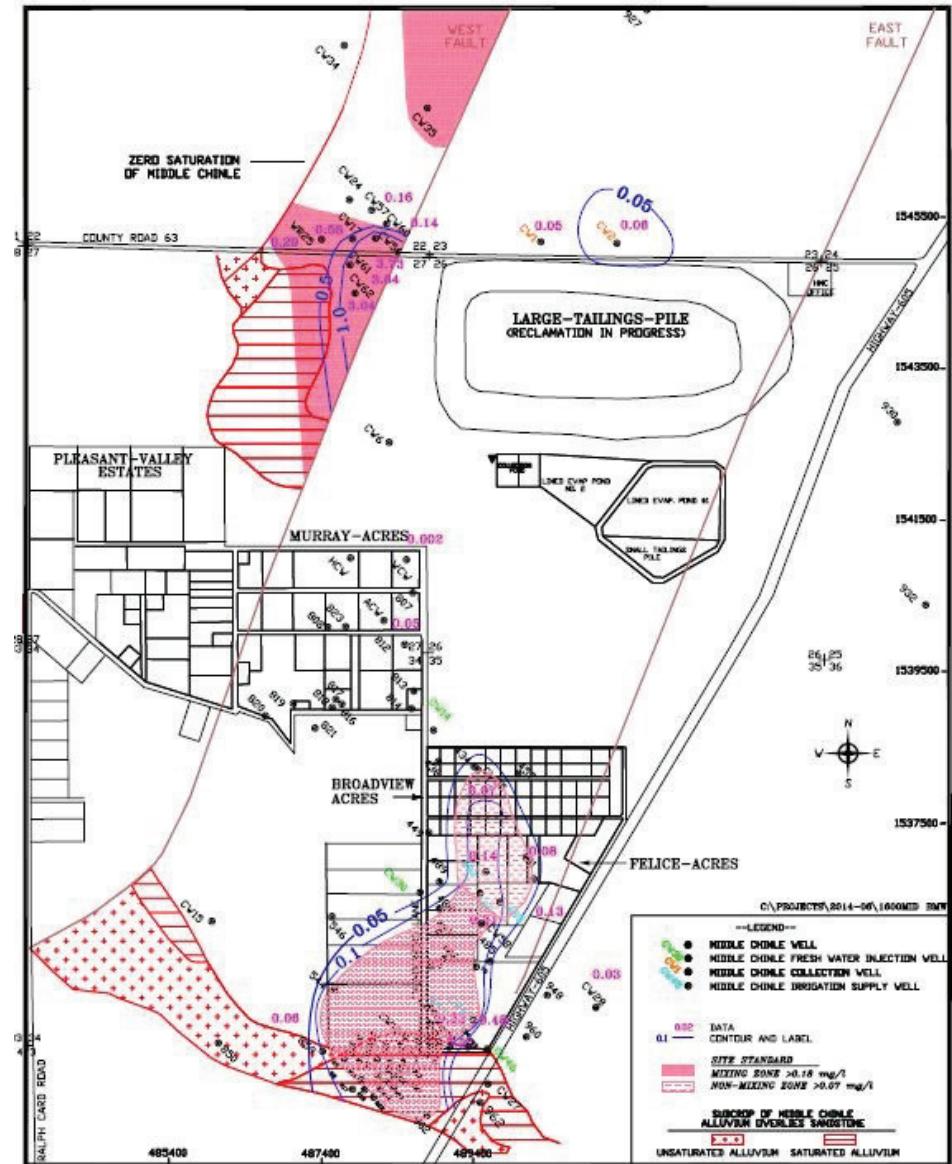
Data from Homestake 2013 Statistical Evaluation Report

	Well	Uranium	Selenium	Molybdenum	Sulfate	TDS	
Cleanup Standards (MZ)		180	140	100	1750	3140	
Mixing Zone	CW-15	15-50	11-42	<30		1446-1710	C/E Block
	CW-17	69-175	69-116	<30-70		1620-3250	Western Block
	CW-24	101-154	34-79	<30-40		3020-3160	
	CW-35	141-231	12-520	<30		1830-2370	
	WR-25						
Cleanup Standards (NMZ)		70	70	100	857	1560	
Non-Mixing Zone	CW-1	<8.5-62	11-90	<30-40		2020-2514	Central and Eastern Block
	CW-2	<8.5-69	<10-30	<10-50		860-2280	
	CW-28	11-61	16-83	<30-30		944-1410	
	ACW	<8.5-25	<10-10	<10-30		1172-1470	
	WCW	<8.5-33	<10-20	<10-30		1170-1980	
	CW-14	10-19	83-222	<30		1306-1486	

URANIUM CONCENTRATION MAP

Middle Chinle

Homestake 2013 Annual Report

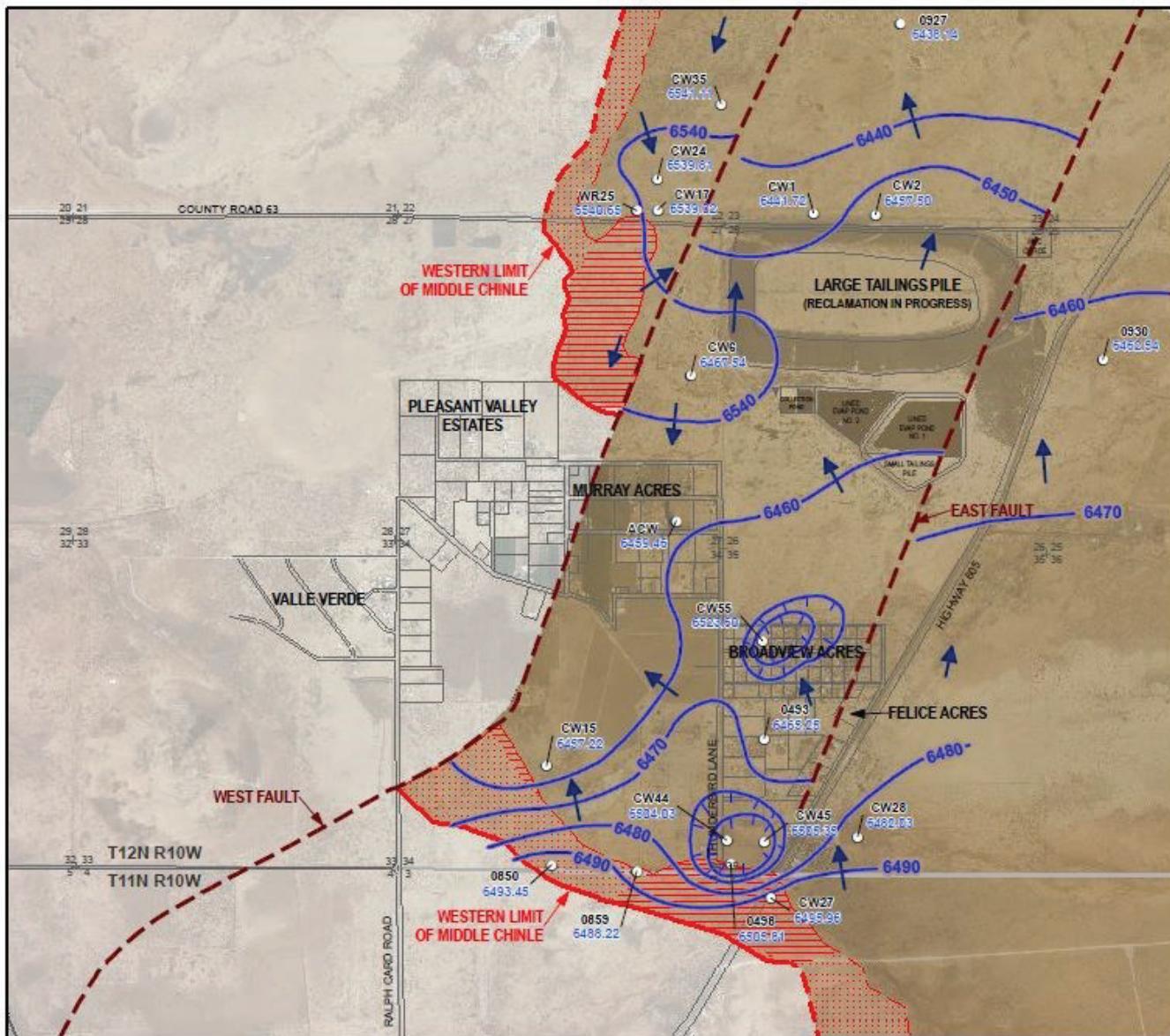


GROUND WATER FLOW MAP

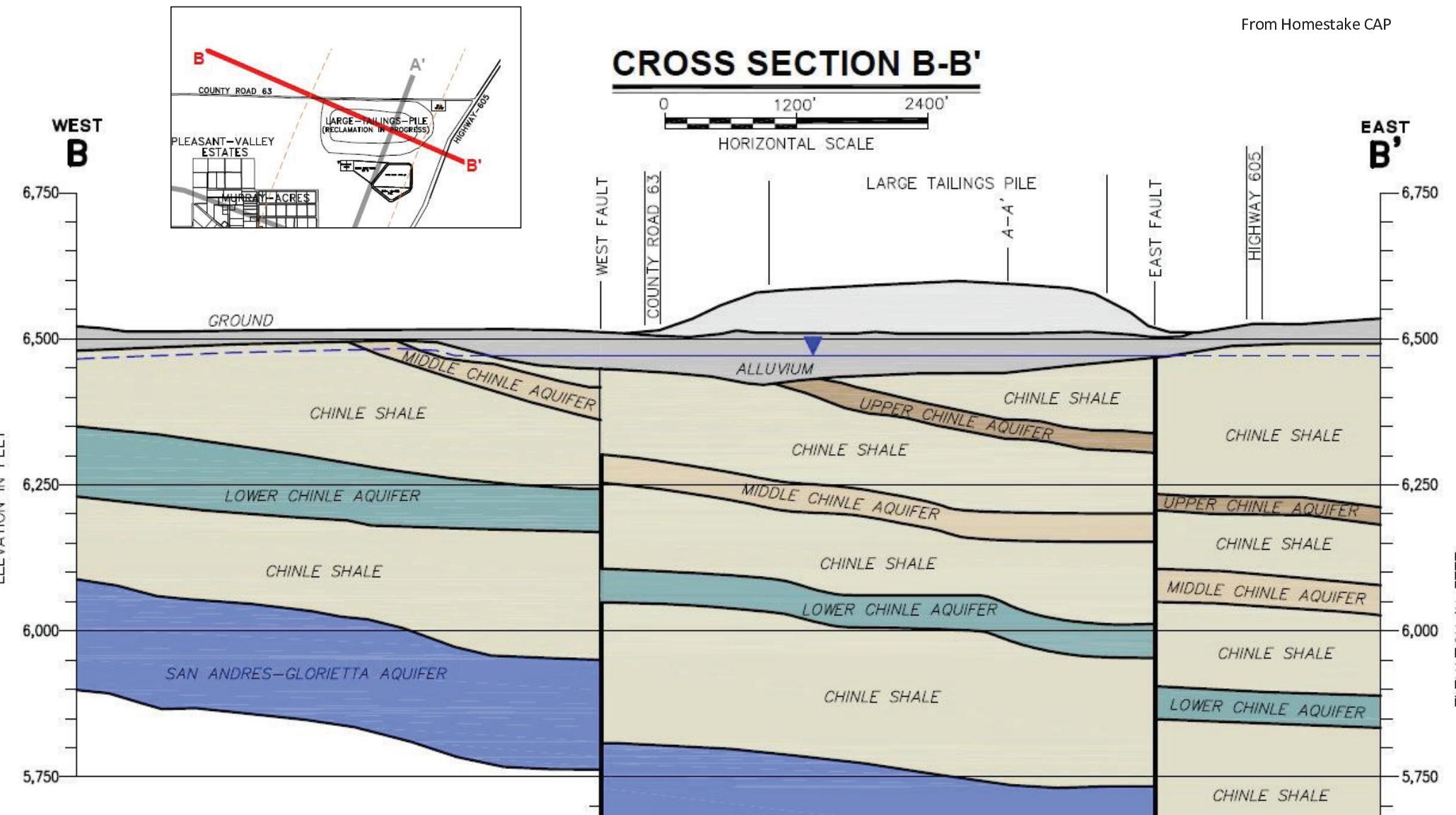
Middle Chinle

Homestake CAP

Aquifer In West Fault Block
Separated From
Central And East Block



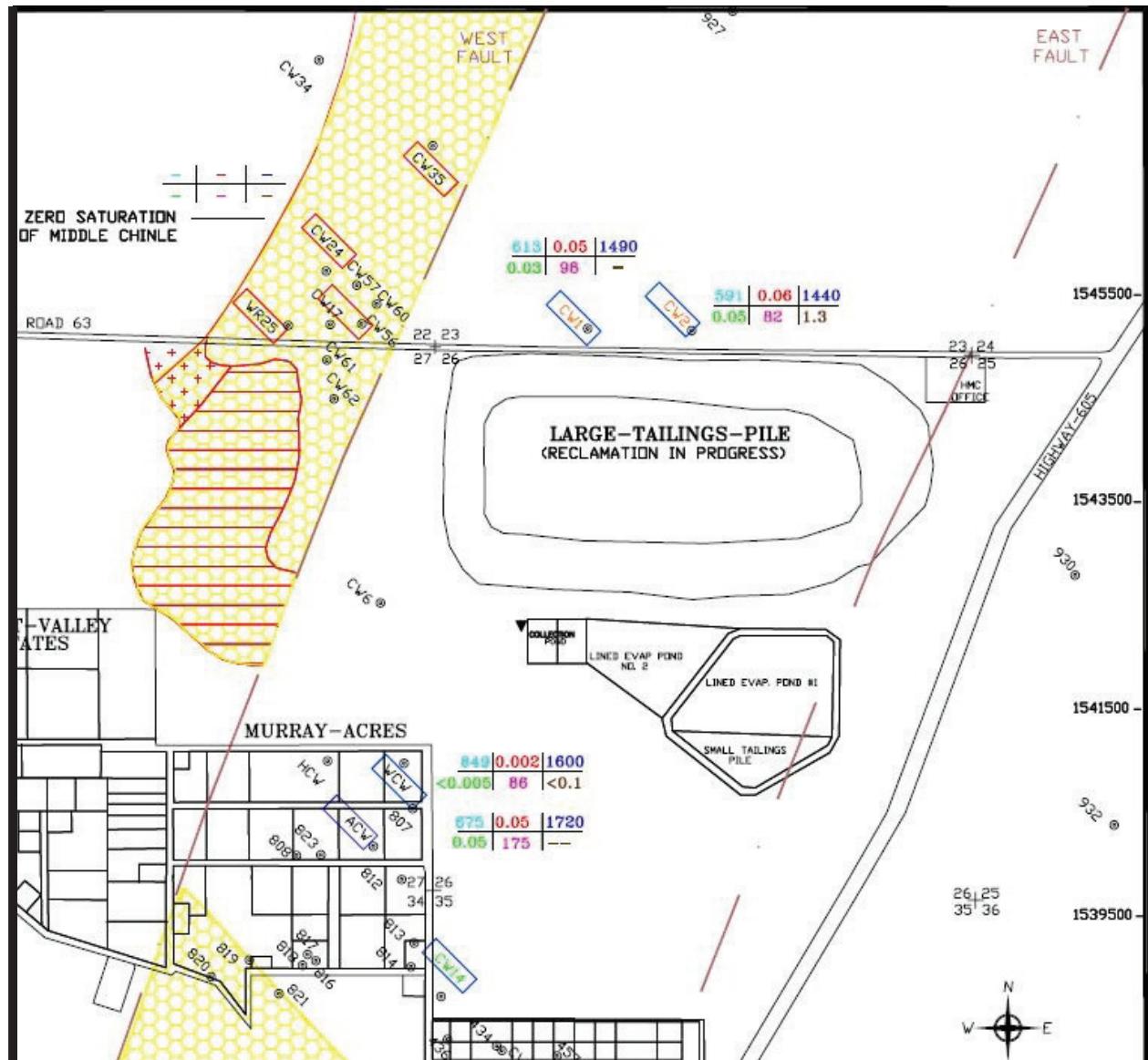
From Homestake CAP



MIDDLE CHINLE

Other Issues for Mixing Zone

- No Non-Mixing Zone water quality west of West Fault?
- Downgradient Extent of Mixing Zone west of West Fault not delineated?



Map from Homestake 2013 Annual Report

LOWER CHINLE

Mixing Zone Wells

- CW-26, CW-29, CW-31, CW-32, CW-33, CW-41
- Background levels seem high

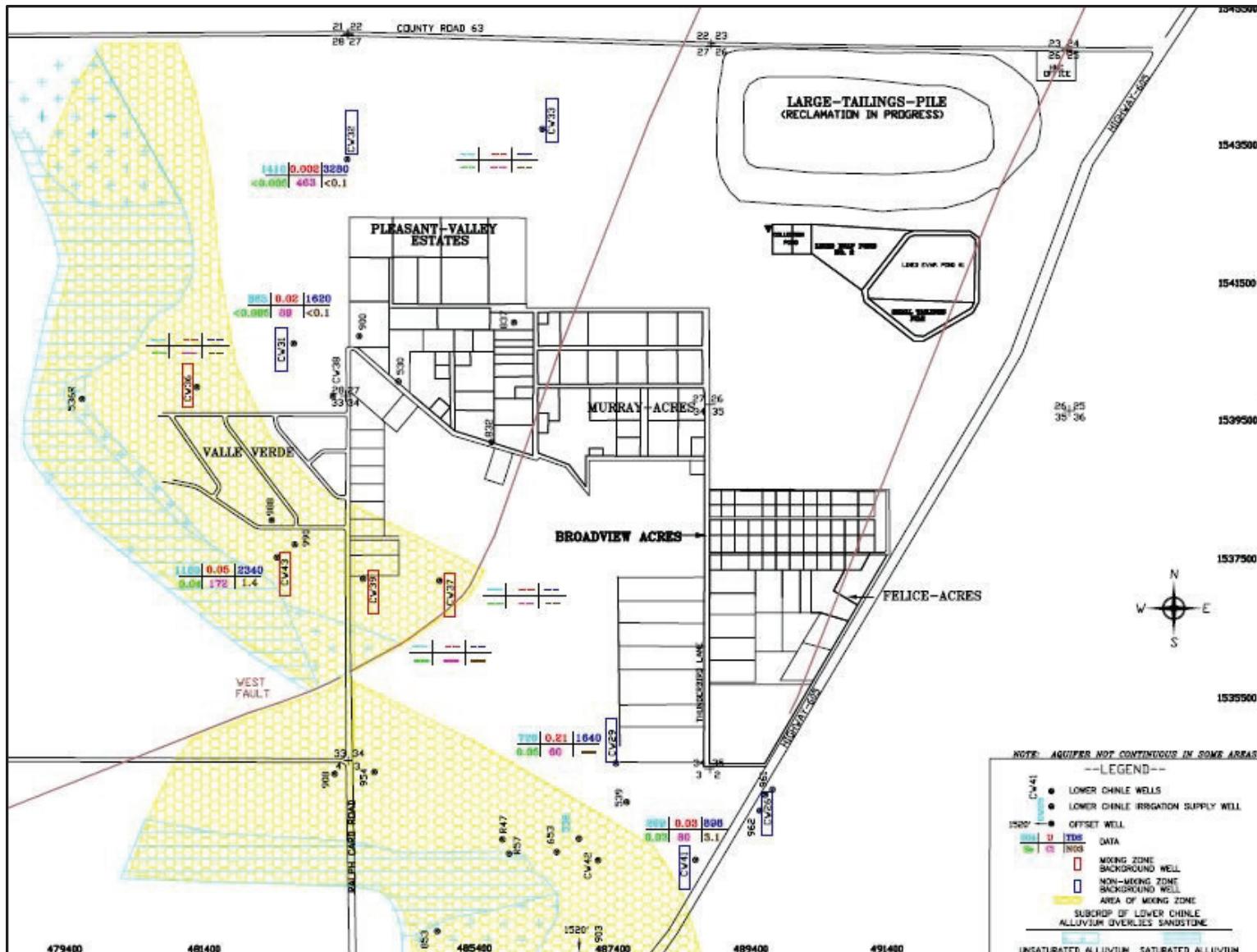
Non-Mixing Zone Wells

- Selenium in C/E Blocks seems high for Non-Mixing Zone
- Water quality is better in private wells than in background monitor wells

Data Availability

- All Wells – 1995-2002 except CW-41
- CW-41-1996-1998

Map from Homestake 2013 Annual Report



LOWER CHINLE BACKGROUND WELL DATA

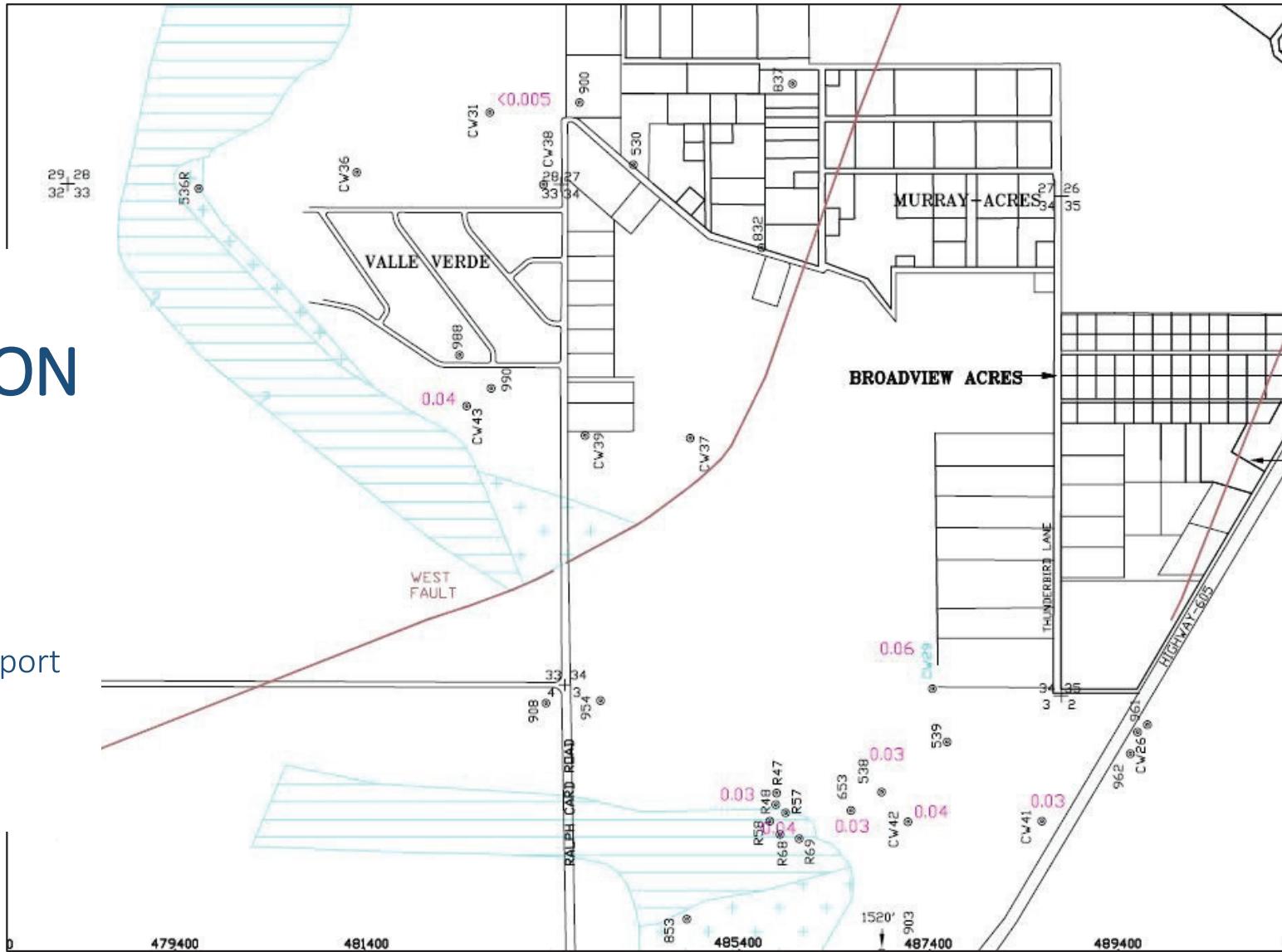
	Well	Uranium	Selenium	Molybdenum	Sulfate	TDS
Cleanup Standards (MZ)		180	140	100	1750	3140
Mixing Zone	CW-36	2-13	<5-35	<30		
	CW-37	24-32	75-96	<30		
	CW-39	17-45	31-85	<30		
	CW-43	21-33	9-25	<30		
<hr/>						
Cleanup Standards (NMZ)		30	320	100	2000	4140
Non-Mixing Zone	CW-26	16-24	192-364	<30-120		
	CW-29	9-53	<14-155	<30		
	CW-31	6-16	<5	<30		
	CW-32	6-10	<10-2570	<30		
	CW-33	<10-26	<10-14	<30		
	CW-41	13-48	8-24	<30		

Data from Homestake 2003 Statistical Evaluation Report

SELENIUM CONCENTRATION MAP

Lower Chinle

Homestake 2013 Annual Report



LOWER CHINLE - PRIVATE WELL DATA

(select wells southeast
of Felice Acres)

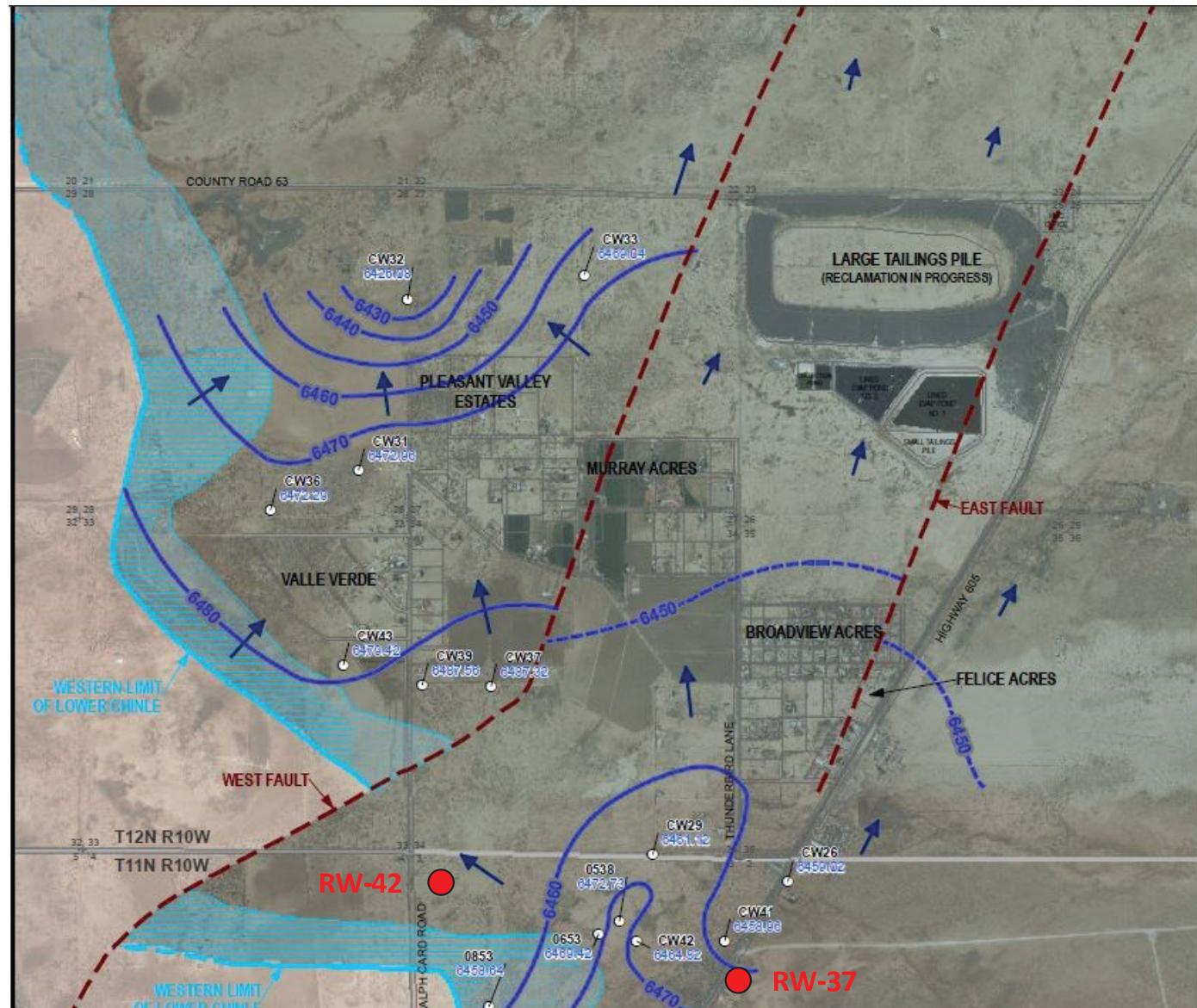
Well	Uranium (ppb)	Selenium (ppb)	TDS (ppm)
RW-37 (963)	15	12	700
RW-38 (572)	11	8	598
RW-42 (954)	6	2	934
RW-44 (574)	17	9	606
RW-47 (964)	16	11	658

Data from NMED Summary Report on 2005-2007 Residential Sampling

GROUND WATER FLOW MAP

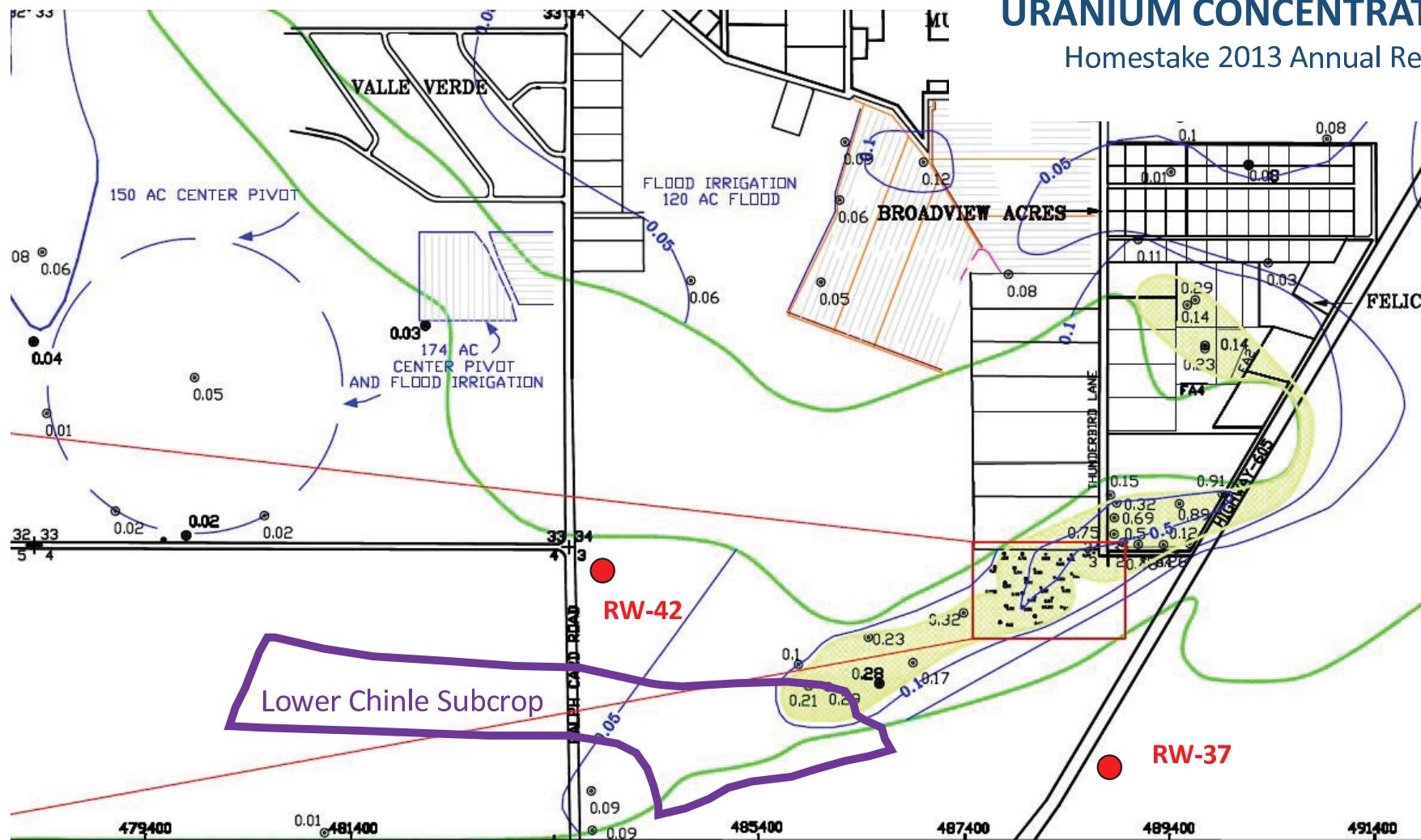
Lower Chinle

Homestake CAP



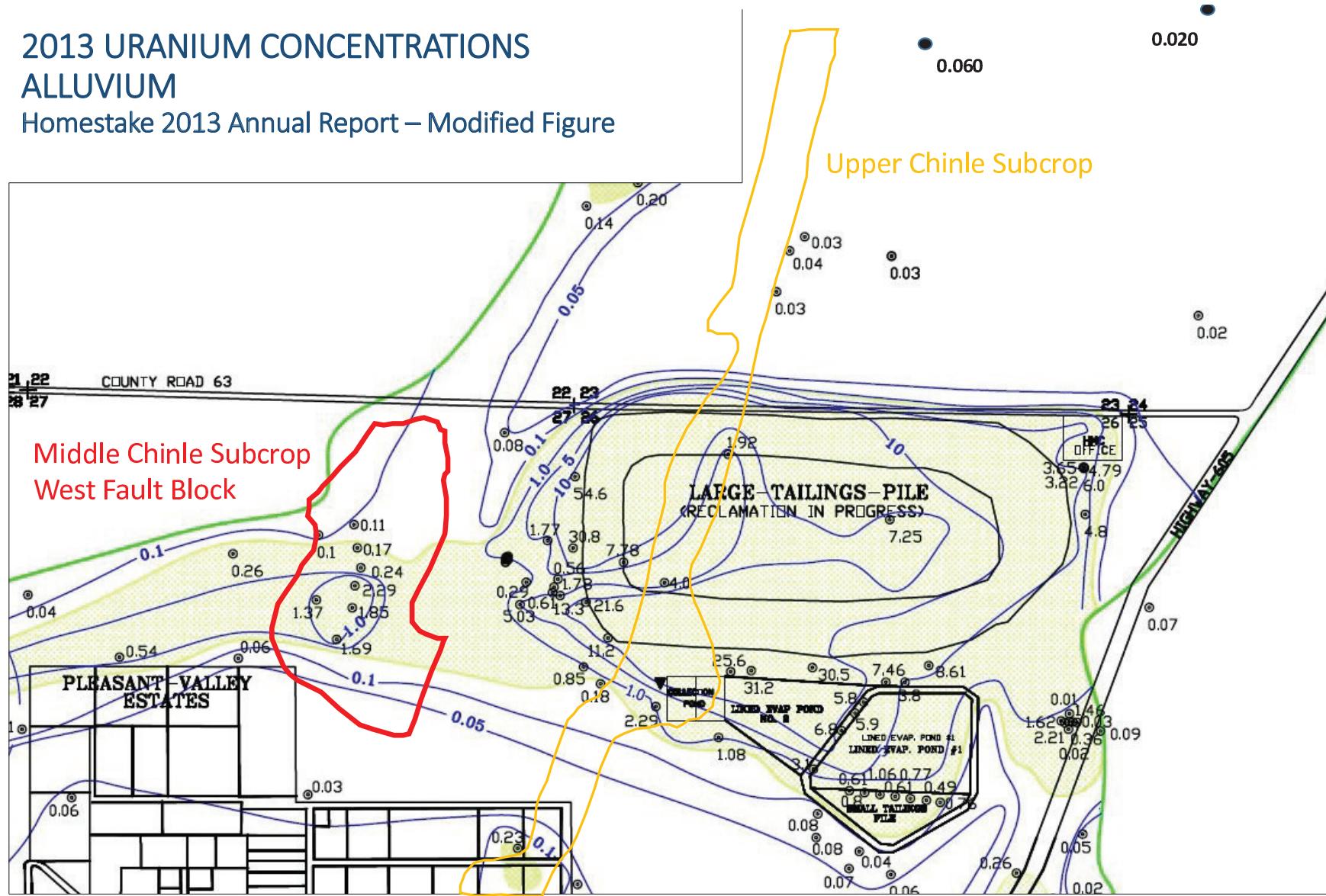
URANIUM CONCENTRATION MAP

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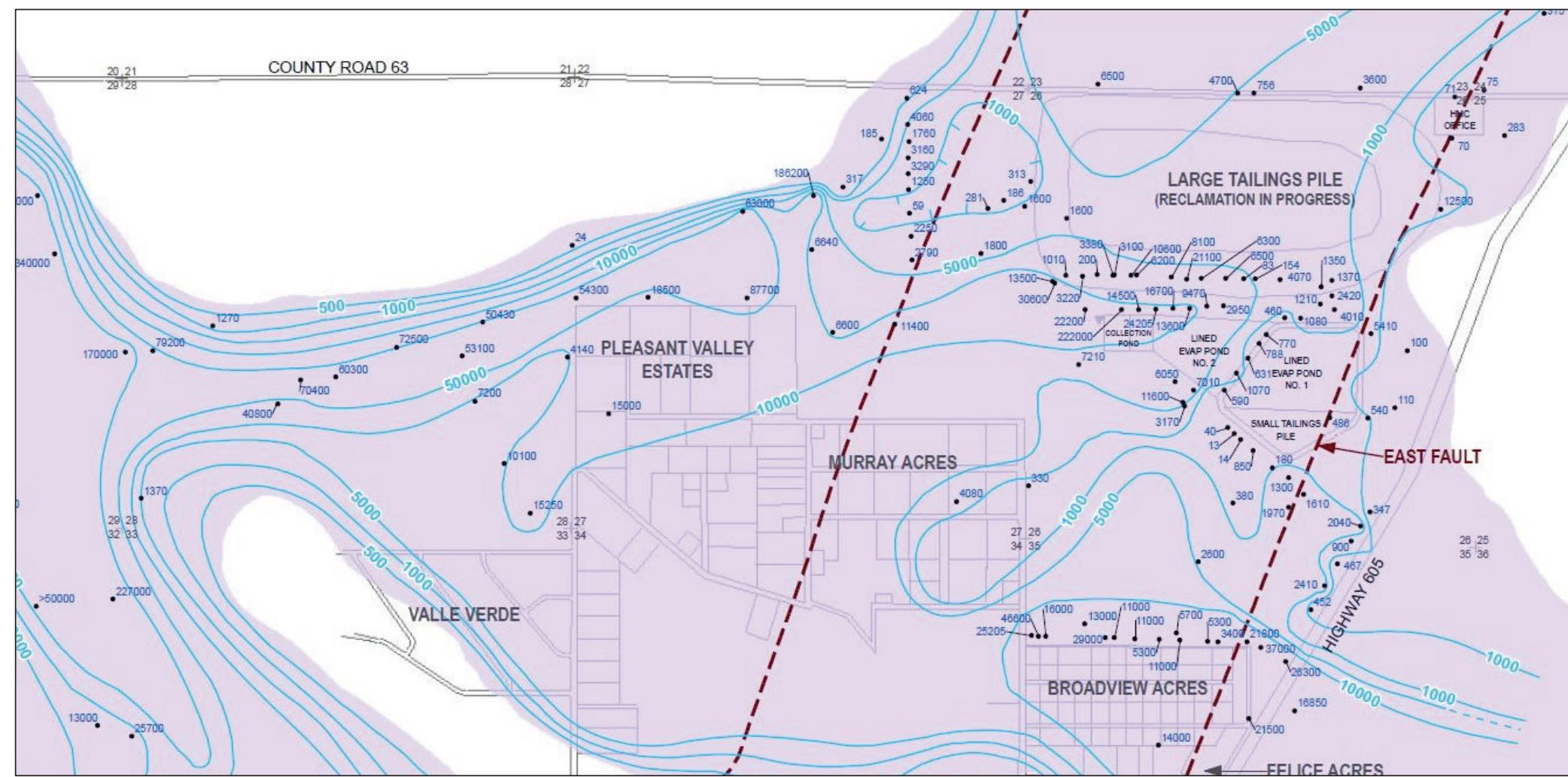
2013 URANIUM CONCENTRATIONS ALLUVIUM

Homestake 2013 Annual Report – Modified Figure



TRANSMISSIVITY – ALLUVIAL AQUIFER

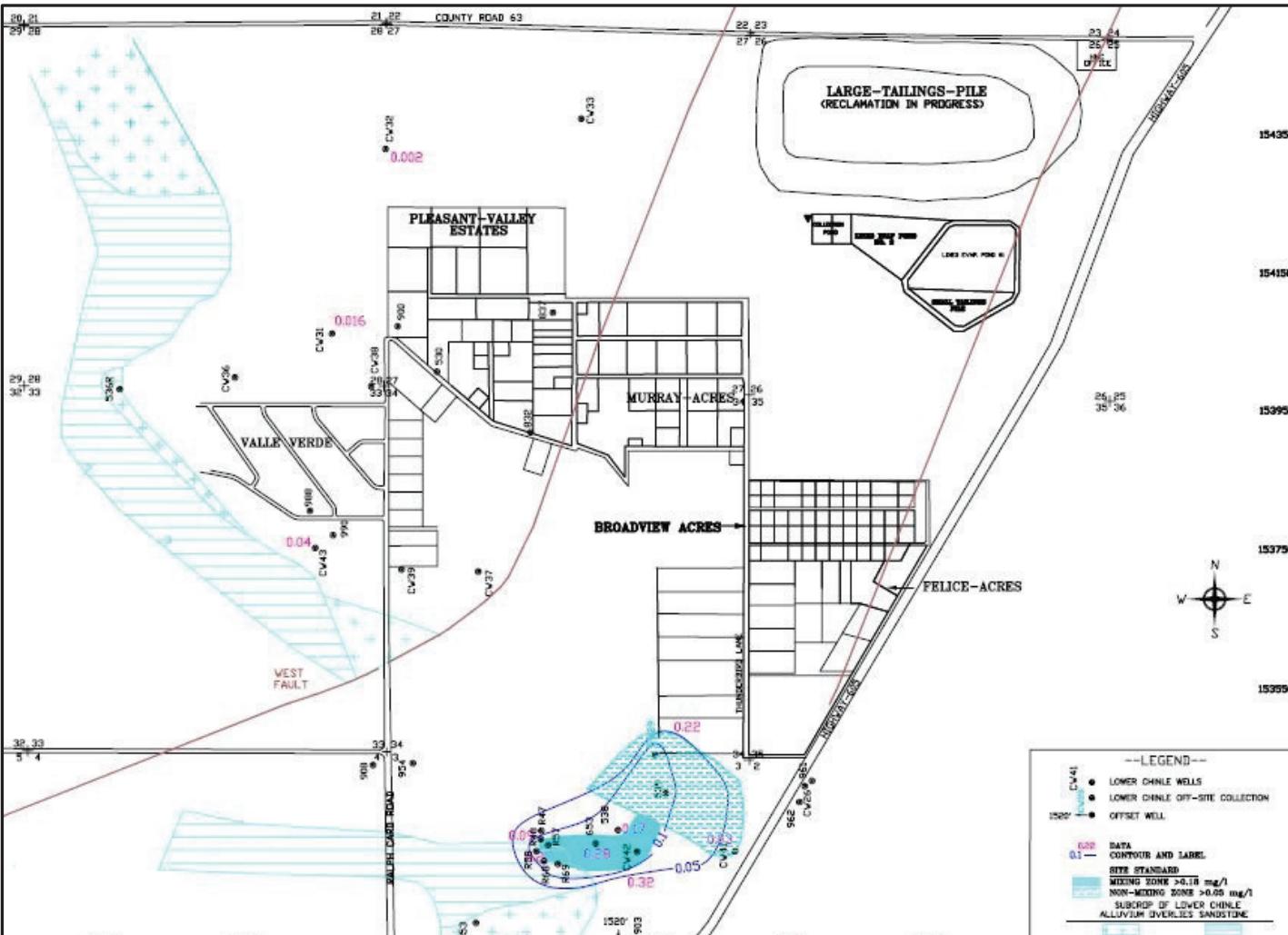
Homestake CAP



URANIUM CONCENTRATION MAP

Lower Chinle

Homestake 2013 Annual Report



GROUND WATER FLOW MAP

Lower Chinle

Homestake CAP

